

impurities and precipitating the choline as the HgCl_2 compound. The choline was determined quantitatively as the reineckate³. Analyses of the HgCl_2 compound and of the reineckate confirmed the identity of choline. The amounts extracted were 20.0 kgm. fresh brewer's grains (containing 22 per cent dry matter) and 2 kgm. dry barley. Brewer's grains yielded 0.25-0.28 per cent choline (calculated as dry matter), whereas normal barley contained *no free choline*. A yield of 0.17 per cent choline was obtained only after saponification with barium hydroxide.

These findings seem to justify the conclusion that free choline can act as a poisoning agent when fed over long periods of time.

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¹ Hoyman, W. G., *Phytopath.*, **31**, 871 (1941).

² Schroeter, G., and Strassberger, L., *Biochem. Z.*, **232**, 452 (1931).

³ Engel, R. W., *J. Biol. Chem.*, **144**, 701 (1942); *J. Nutrit.*, **25**, 441 (1943).

A Possible Gene Duplication in New Zealand Romney Sheep

THE mode of inheritance in New Zealand Romneys of the N-type birthcoat, in which there is very high abundance of halo-hairs on the main area of the body, has been shown to be simple in three stocks of sheep^{1,2}. In two stocks of independent origin N-type is a simple dominant to non-N. In the third, which is related to one of the dominant stocks through a common ancestor, the breeding experiments of the last two seasons have given further proof that N-type is a simple recessive to non-N. In addition, a small inbred N-type flock in which the mode of inheritance is multifactorial has been gradually but rapidly built up by selection.

Nearly all N-type rams, of whatever stock, are horned. It was formerly thought that in dominant-N sheep horns were conditioned by a sex-influenced factor linked with the factor for N-type with about 10 per cent crossing-over. It is now better to regard horns as a usual expression in males of any genetic make-up which gives an N-type birthcoat. In females the breeding results point to homozygous dominant-N animals ordinarily having horns, which are much smaller than most rams' horns. Occasional heterozygous dominant-N ewes are horned or have scurs or buttons, the latter being hard projections which do not pierce the skin. Recessive-N ewes have so far all been polled. So have most multifactorial-N ewes, but a few have horns, and several have scurs or buttons.

The central problem in genetic analysis is the relation between dominant-N and recessive-N. In developing earlier ideas, as two more crops of lambs have been born, emphasis is put the more on duplication, and it no longer seems helpful to think in terms of a dominigene or a suppressing factor. The present hypothesis is simply that the dominant factor for N-type is a duplication of the recessive gene for N-type. There is a substantial chance that in the experimental stocks the recessive gene has been duplicated on one or more occasions, and that the supposed dominant duplication has, once or a few times, been halved to give a germ cell possessing the recessive gene. The grounds for thinking that these things happen are not yet conclusive, and the main

purpose of the breeding experiments has become to test the hypothesis that has been stated. We must ascertain whether dominant-N, non-N and recessive-N are multiple alleles, and must give more lambs suggestive of unequal crossing-over or the halving of a duplication the chance to be born.

If such crossing-over does indeed take place the data suggest its frequency to be nearer 1 in 100 than 1 in 10 to any other power. For an event that one thinks of as a rare abnormality this frequency seems high, but that it can happen so often is believable in the light of *Drosophila* work^{3,4,5}. If a duplication were advantageous to the live-stock breeder, and took place with a frequency of this order, it would be worth while for him to watch for it. Moreover, the recent work on *Drosophila*, following the discovery that 'bar' is a duplication, suggests that this phenomenon is more than an out-of-the-way oddity. In the mouse, too, duplication may well be involved in the work of Dunn and Caspari⁶. Without the *Drosophila* work the present hypothesis seeking to explain sheep-breeding results would assuredly not have been put forward. Problems of selection in slow-breeding animals being so difficult, it is tempting to speculate on the possible significance for live-stock breeding of the duplication of a gene which thereby becomes in some way more powerful.

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¹ Dry, McMahon and Sutherland, *Nature*, **145**, 390 (1940).

² Dry and Sutherland, *Nature*, **148**, 563 (1941).

³ Demerec and Hoover, *Genetics*, **24**, 271 (1939).

⁴ Lewis, *Proc. U.S. Nat. Acad. Sci.*, **27**, 31 (1941).

⁵ Oliver, *Proc. U.S. Nat. Acad. Sci.*, **26**, 452 (1940).

⁶ Dunn and Caspari, *Proc. U.S. Nat. Acad. Sci.*, **28**, 205 (1942).

The Commutation of Annual Subscriptions

I WAS interested in Dr. David Heron's letter in *Nature* of September 23, p. 400. The Royal Aeronautical Society allows compounding of annual subscriptions after payment of the entrance fee and first annual subscription, as follows: fellows, 12 years subscriptions; associate fellows and other grades, 15 years subscriptions. The amounts are reduced by one guinea a year for each year of membership after five years. The minimum ages for fellows is twenty-eight and associate fellows twenty-five. An additional compounding fee is payable on transference from associate fellow to fellow if the former has already compounded his subscriptions, on a *pro rata* basis of annual subscriptions. The whole of the entrance fees and life compositions are invested in an endowment fund, the interest only of which is available to the Society's funds. It will be noticed that the composition fee is irrespective of age. An associate fellow elected at twenty-five can compound for fifteen years subscription, while one elected at thirty-five will still have to pay the same composition fee. The fees were adopted on the advice of the Society's honorary accountant.

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