

of 1 kgm. per cm.<sup>2</sup>, corresponding to a temperature of 120° C. The inoculated flasks were incubated at 20° C. for 60 days.

TABLE 1. INFLUENCE OF GLUCOSE CONCENTRATION ON THE GROWTH OF ISOLATED PINE ROOTS

| Glucose, per cent | Average total length of 14 roots in mm. | Average number of branches |
|-------------------|---|----------------------------|
| 2                 | 7.8                                     | 2.5                        |
| 3                 | 26.3                                    | 3.6                        |
| 4                 | 46.1                                    | 4.2                        |
| 5                 | 21.6                                    | 3.1                        |
| 6                 | 9.8                                     | 2.0                        |

TABLE 2. INFLUENCE OF SUCROSE CONCENTRATION ON THE GROWTH OF ISOLATED PINE ROOTS

| Sucrose, per cent | Average total length of 14 roots in mm. | Average number of branches |
|-------------------|---|----------------------------|
| 3.9               | 14.7                                    | 2.5                        |
| 5.8               | 79.4                                    | 7.4                        |
| 7.7               | 28.3                                    | 2.9                        |
| 9.6               | 6.6                                     | 2.3                        |
| 11.6              | 0.0                                     | 0.0                        |

Some results obtained in assaying the influence of different sugar concentrations on the growth are listed in Tables 1 and 2. In these experiments the nutrient solutions contained 2-6 per cent glucose or of sucrose in a corresponding molarity (3.9-11.6 per cent). The optimum glucose concentration was found to be 4 per cent, while the optimum sucrose concentration was 5.8 per cent, in molarity equivalent to 3 per cent glucose.

Sucrose gave rise to considerably more powerful growth and more branches than glucose, and may hence be a more suitable source of carbon for isolated pine roots than the latter.

The investigation is being continued.

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<sup>1</sup> Kujala, V., *Comm. Inst. Quaest. Forest. Finland.*, 12 (1927).

<sup>2</sup> Wilson, J., *Amer. J. Bot.*, 2, 420 (1915).

<sup>3</sup> Melin, E., "Abderhalden: Handb. biol. Arbeitsmethoden", Abt. XI, Teil 4, 1,015 (1922).

<sup>4</sup> Robbins, W. J., and White, V. B., *Bot. Gaz.*, 98, 209 (1936).

## Mendelian Inheritance in New Zealand Romney Sheep

THE present purpose is to report further changes in our views on the genetics of *N*-type sheep. As stated and illustrated previously<sup>1,2,3</sup>, these animals have very high abundance of halo-hairs in the birth-coat, and their fleeces are usually hairy, that is, have much medullation. Of our four *N*-type stocks, one has been called 'multifactorial-*N*', two are 'dominant-*N*' and one 'recessive-*N*'.

The so-called multifactorial-*N* stock is related to both dominant-*N* stocks, Nielsen-*N* and Massey-*N*. Evidence from experiments not quite complete points to the *N*-gene being the same in both dominant stocks. Breeding tests still in progress make it probable that the 'multifactorial' stock is multifactorial only for modifiers aiding the expression of the dominant-*N* gene. The foundation animals, among the descendants of which selection for *N*-type proved rapidly successful, all had many halo-hairs, but fewer than *N*-type. The original ram, which was horned, and to which the whole stock is traceable, and several of the earliest ewes, were so bred that they could be heterozygous for the dominant-*N* gene. By this time we are familiar with the fact that the dominant-*N* gene may come to poor or even very poor expression in heterozygotes. Finding ourselves thus without any stock that can be regarded as multifactorial in

the sense that no one gene plays a major part, we are the more anxious that the genetics of the coats of the hairy mountain sheep of the northern hemisphere should be studied.

Our central problem is the relation between dominant-*N* and recessive-*N*. For four years the hypothesis under test has been that dominant-*N* was a duplication of recessive-*N*. The two genes would then be allelomorphous. *N*-type sheep have been secured from the mating of recessive-*N* and dominant-*N*. Two such recessive-dominant *N*-type rams have been mated with recessive-*N* ewes. The lambs are 20 *N*-type; 7 non-*N*. Four of the non-*N* lambs are by one ram, three by the other. This is the 3:1 ratio expected if the genes are independent. The hypothesis is therefore no longer tenable. We are the more anxious to announce this result because reference has been made to this hypothesis by Prof. Ruggles Gates<sup>4,5</sup>. Sheep-breeding experiments take a long time, and it is therefore our policy to pass ideas to fellow-workers in a manner which would be thinking aloud too much if mice were our material.

Recently, we enjoyed the privilege of discussing this work with Prof. Richard Goldschmidt during his visit to New Zealand. He pointed out how often the same character in *Drosophila* is conditioned by different genes, and told us that the simplest interpretation is complete independence of the dominant-*N* and recessive-*N* genes. There is, however, evidence from breeding results, the critical discussion of which would take too much space, which allows us still to wonder whether the two genes, though resident on different chromosomes, may indeed be the same. It is suggestive, too, that in both dominant-*N* and recessive-*N* sheep the same pleiotropic effects occur. The problem is being tackled by further breeding, and one of us (A. S. F.), whose earlier research has been in plant cytogenetics, is studying the chromosomes of rams of different genotypes.

The fact that the two genes are carried by different chromosomes gives greater scope for the study of dosage effects. Horns in ewes, for example, are the rule in homozygous dominants; small horns are frequent in recessive-dominant ewes; horns occur occasionally in heterozygous dominants; and they have not yet been recorded in recessive-*N* ewes. Other characters are being studied in the series of genotypes, notably the abundance of the several fibre types of the birth-coat.

Our attention has recently been directed to the possible application of this fundamental work. In the early days of this College, research was started on hairiness because it was regarded as a wool fault. Then the emphasis came to be put on the genetics of *N*-type. Early in 1946, Prof. A. F. Barker visited New Zealand and spent several days at this College. He urged the breeding of *N*-type sheep on a larger scale in order to supply one of the world's best carpet wools.

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<sup>1</sup> *Nature*, 145, 390 (1940).

<sup>2</sup> *Nature*, 148, 563 (1941).

<sup>3</sup> *Nature*, 154, 552 (1944).

<sup>4</sup> *Amer. Nat.*, 80, 76 (1946).

<sup>5</sup> "Human Genetics", 17 (New York, 1946).