haviour, and surface properties are being studied as well as performance during commercial processes.

This communication indicates only the salient features of a felting lustrous mutant Merino fleece-type and its research and commercial potential. Detailed data will be published elsewhere.

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[1] Fraser, R. D. B., and Rogers, G. E., *Aust. J. Biol. Sci.*, 8, 288 (1955).

Williamson's Theory of Interspecific Competition

In a recent communication[1], Williamson sets out to explore the results of competition between two species of animals living together in the same place. He defines a controlling factor and builds his model on this definition. He says "a car needs more steering on a rough road than on a smooth one" and argues by analogy that a controlling factor is more important in a stochastic than in a deterministic model. Steering is only necessary on any road because the driver wishes to stay alive and reach his destination. Does Williamson imply that controlling factors are necessary because the mathematician wishes to keep his population extant and directed towards his goal ? It may be proper for a mathematician to have such a wish but it is scarcely relevant to the study of natural populations since extinction is the usual fate of most populations and probably the inevitable fate of all[2].

In order to proceed with his model, Williamson makes five assumptions which delimit the meanings of the symbols he is to use in his mathematics. He then proceeds to derive his equations (8) and (9) which describe the course of competition between two species. He shows that under the conditions specified in these two equations the "two species are in stable equilibrium although there is but a single controlling factor which acts on both". To this point we can perhaps go with Williamson (although, as has been pointed out elsewhere[2], there are grave difficulties associated with his concept of environment) ; but in the next sentence he makes the following statement : An example of this would occur if two species of snail were controlled by a single species of bird, and if the bird tended to prefer whichever snail was the commoner both species of snail could persist". This statement can be read only in the context of Williamson's five assumptions. In this context its proper meaning should be expressed somewhat as follows : An example of this would occur if two species of snail, the individuals of each of which were all of the same sex, stayed always at the same age and were genetically identical, and which in reproducing gave rise instantly to mature adults identical with themselves, lived in a place in which the topography was quite uniform, where food, which had the property of being always replaced just as fast as it was eaten, was uniformly distributed and did not vary in quality, where the seasons were identical and where the time of day and the weather did not change. If these two species were preyed upon by a single species of bird (the individuals of which had characteristics similar to the snails) and if the bird tended to prefer whichever was the commoner snail, both species of snail could persist, provided that no animals entered or left the area and the numbers of snails always remained large enough for deterministic rather than stochastic equations to be used and for the numbers to be treated as continuous variables.

What must be the courage of the mathematician who feels free to make the dizzy leap from his abstract symbols to the real snails and birds of this world ? What heavy chains of empiricism must we wear who fear to follow him in his flight ?

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Nov. 4.

[1] Williamson, M. H., *Nature*, **180**, 422 (1957).
[2] Andrewartha, H. G., and Birch, L. C., "The Distribution and Abundance of Animals" (University of Chicago Press, 1954).

I am glad that Drs. Andrewartha and Browning have been able to go some way with me. I hope that the following remarks will help them to travel further. The example of the car was used as an analogy, not as an argument. Any population that persists for more than a few generations must be controlled : any car that progresses more than a few yards without accident must be steered. To say that no age distinctions are recognized does not mean that all individuals are of the same age. It means that the probability of an event, such as being eaten, happening to an individual is independent of that individual's age. My other assumptions should be interpreted in the same sort of way. I made no assumptions about food ; the only one needed is that there is enough of it. Land snails are usually hermaphrodite and so all of the same sex.

My equations may perhaps be compared to anatomical diagrams. They attempt to represent what I think are the important points in population dynamics, in the same way that a diagram brings out the important points of anatomy. Neither is intended to be a complete representation.

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Effect of Photoperiod on the Oxygen Consumption of Two Species of Intertidal Crabs

Light as an environmental parameter has been given slight consideration with respect to its effect on rate functions of intertidal marine invertebrates. Prosser[1] has mentioned a few examples where light has been considered as a limiting factor. Most of these examples have concerned vertebrates. Recently, Hoar[2] demonstrated that different light periods affected thermal resistance in goldfish. Short-day (8 hr.) photoperiod fish were more resistant to cold than long-day (16 hr.) ones. The reverse was true for heat adaptation.

Measurements of oxygen consumption of two local intertidal species, *Hemigrapsus nudus* and *Hemigrapsus oregonensis* have been made under different conditions of temperature and salinity. These results have been recorded throughout the year on animals maintained for twenty-four hours at temperatures and salinities which approximated seasonal conditions (rate/temperature experiments). Other experiments have involved the acclimation of both winter and