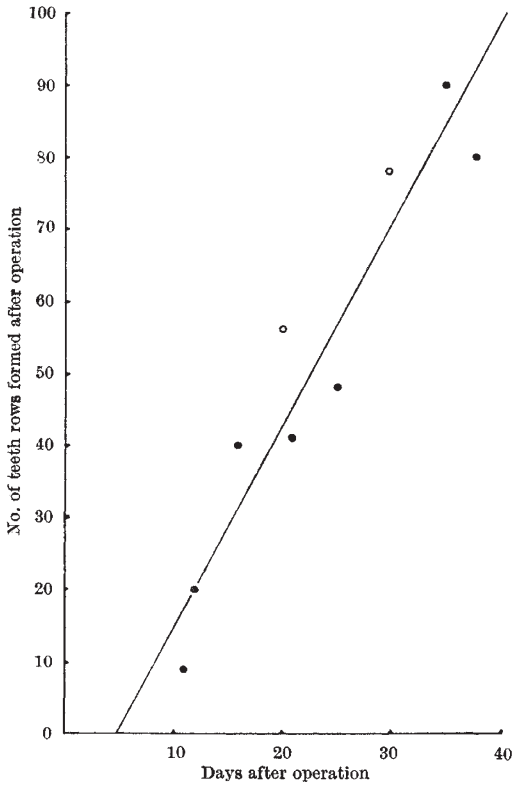

Fig. 1. Rate of radula replacement. ●, Number of new rows; ○, 110—number of remaining old rows

From Fig. 1 it can be seen that the animals took approximately 5 days to recover from the operation and that the rate of replacement of the radula was very approximately 2·8 rows a day, that is, an average radula (110 rows) would be completely replaced in about 40 days. In animals killed at 68 and 69 days none of the old radula remained. This very rapid replacement-rate accounts for the fact that, while there is a very great difference in size between the radula teeth of young and old individuals, in any one animal the teeth at the old and the new ends of the radula are approximately the same size.

N. W. Runham

Department of Zoology,
University College of North Wales,
Bangor.

[1] Carriker, M. R., *Nautilus*, **57**, 52 (1943).
[2] Joose, J., and Lever, J., *Proc. Kon. Ned. Akad. V. Wetensch., Amsterdam*, C, **62**, 145 (1959).

Fate of the 'Tail' during the Larval Development of *Raillietina cesticillus* in the Confused Flour Beetle, *Tribolium confusum*

Unparasitized confused flour beetles were fed cast proglottids of *R. cesticillus*, and were then maintained on whole wheat flour, without being re-infected.

During the early development of the cestode, the tail arises as a posterior lobe which gradually constricts at the base to form a slender stalk. Usually, some of the six larval hooks are included in the tail while others remain in the stalk or body. The tail is pinched off as a small, perfect sphere, the stalk remaining attached to the body. The tail is shed at the end of the procercoid-like phase of development, designated as stage 5 by Wisseman[1], and is therefore lost at the same stage as in the primitive pseudophyllidean life-cycle.

The cast tail does not disintegrate, but survives and proliferates while the body continues its normal development to the cysticercoid stage. The tail becomes indented and lobed, its shape becoming increasingly irregular as it enlarges. It usually begins to lose its spherical shape when development of the body has reached stage 10 of Wisseman, which precedes the withdrawal of the scolex into the posterior portion. One abnormal animal was observed in which the tail had not been cast, and was enlarged and misshapen while still attached to the body; the scolex was well developed.

The growth of the tail is unaccompanied by differentiation, and is unregulated and unlimited, often resulting in bizarre shapes. Eventually a very large, lobular mass of proliferating material is produced. The lobes are drawn out at the base into fine stalks and are constricted off as rounded bodies. The stalks remain projecting from the main cellular mass. The spherical bodies, which are usually without hooks, appear in turn to increase in size.

The proliferation of the cast tail is of no advantage to the species, and probably requires nutrients from the hæmolymph of the host which could be utilized by the developing cysticercoids. The process is not one of asexual reproduction; the cellular masses do not differentiate, and are not protected against digestion in the gut of the definitive host.

This work was financed by U.S. Public Health grant No. *E* 2992-*C*1.

Joan B. Williams*

Department of Zoology,
Rutgers University,
New Brunswick,
New Jersey.

* Present address: William Goodenough House, Mecklenburgh Square, London, W.C.1.

[1] Wisseman, jun., C. L., *Trans. Amer. Micro. Soc.*, **64**, 145 (1945).

Preservation of Tissue Culture Cells with Liquid Nitrogen

For prolonged storage of biological materials it is generally considered that temperatures of −100° C. or lower are necessary[1], and as thermodynamic changes have been demonstrated in mixtures of glycerol and Earle's solution in this temperature region[2] and in ice at −130° C.[3] it is preferable to use a lower storage temperature such as is provided by liquid nitrogen.

Storage in a small liquid nitrogen flask such as the Linde *LNR-25-B* (supplied by Union Carbide, Ltd., 8 Grafton Street, London, W.1) is now practical for small laboratories and it provides a temperature of −195° C. in the liquid and −185° C. in the gas.

In order to freeze tissue culture cells for low-temperature storage it is recommended that the average rate of cooling should be not more than 1° C. per minute down to −25° C.[1,4], and to do this several devices have been made[4–6]. With the liquid nitrogen flask it was felt that the normal continuous loss of cold nitrogen gas could be conveniently used as the coolant and the following simple procedure was devised.

It consists of a plug of expanded polystyrene ('Polyzote', supplied by Expanded Plastics, Ltd.,