calanus in the Baltic relict lakes is supposed to have occurred. It is thought that *Mysis oculata* and *Limnocalanus grimaldii* in the Yoldia Arctic sea became modified during the succeeding period of the freshwater Ancylus lake into forms resembling *Mysis relicta* and *Limnocalanus macrurus*, which became isolated in the smaller freshwater lakes which were cut off from the arms of the Ancylus lake by subsequent changes in relative level of land and sea. In this early post-glacial period, covering Zones IV, V and VI of the pollen zonation, the stratigraphy and pollen diagram of this core from the western end of Ennerdale correspond closely with the succession in Windermere, and show that the sequence of deposits is complete and conformable. The curves for pollen of the forest trees show the normal course for these zones in north-west England, and the horizon of the Boreal/Atlantic transition, Zone VI/VII, is clearly marked at 450 cm. below the mud surface. Throughout this period of Zones IV, V and VI, abundant remains of freshwater diatoms make up a significant proportion of the deposits, and prove that not even brackish water was present. The diatoms belong to species identified from deposits of similar age in Windermere and Kentmere[4,6]; many of them are epiphytes on freshwater plants. It can be taken as proved beyond doubt that at the time when, in the Baltic, changes in land/sea-level and alternations of salt and fresh water were leading to the isolation of *Mysis relicta* and *Limnocalanus macrurus* in relict lakes, Ennerdale Water remained a deep freshwater lake of approximately its present shape. So the reason for the presence here of these two crustaceans must be different from that which has been put forward for the relict lakes.

Finally, a survey of the bottom deposits of the deep, upper, eastern basin of Ennerdale Water has disposed of any suggestion that sea-water may have been trapped here. Slumping of clay and organic muds down the steep sides of this basin has destroyed the conformable succession at the boundary between late- and post-glacial periods, but below the slumped and mixed-up layers of Zones II, III and IV, lie more or less horizontal laminated clays, which contain no organic remains and prove that no sea-water was in the basin when they were formed. The slumped deposits of Zones II, III and IV, and the overlying organic muds of Zones V, VI and VII, contain abundant freshwater diatoms of the same species as in Windermere, and show no evidence of a different history from that lake.

W. Pennington
(Mrs. T. G. Tutin)

University of Leicester.

[1] Gurney, R., *Discovery*, **9**, 108, 1 (1928).
[2] Tattersall, W. M., *Ann. Mag. Nat. Hist.*, II, **9**, 417 (1942).
[3] Eastwood, T. *et al.*, Geological Survey Memoir, 9 (1931).
[4] Pennington, W., *New Phyt.*, **42**, 1 (1943); *Phil. Trans. Roy. Soc.*, B, **233**, 137 (1947).
[5] Round, F. E., *J. Linn. Soc. Bot.*, **55**, 662 (1957).
[6] Round, F. E., *New Phyt.*, **56**, 98 (1957).
[7] Godwin, H. *et al.*, *Proc. Roy. Soc.*, B, **147**, 352 (1957).

Life-Cycle of *Cyathostoma lari*, Blanchard 1849 (Nematoda, Strongyloidea)

During an investigation into helminth parasitism in wild birds in northern England, specimens of an unusual nematode, *Cyathostoma lari* E. Blanchard 1849, were recovered from a variety of host species. *C. lari*, a parasite of the nasal and orbital sinuses of gulls[1,2], has been recorded only at infrequent intervals in various parts of Europe and was not known to occur in Britain until Burt and Eadie[3] recovered it from *Larus ridibundus*, *L. cinereus*, *Corvus frugilegus*, *C. monedula*, *C. corone*, and *Tringa totanus* in Scotland (St. Andrews). I have also found it in the first four hosts listed above and additionally in *Sturnus vulgaris* and *Ardea cinerea*.

Since little is known of the life-cycle of any species of *Cyathostoma* it was decided to investigate its mode of transmission. However, since this parasite is mainly restricted to juvenile birds, material was not readily available at all times of the year and therefore only two preliminary experiments have been possible to date.

Eggs extracted from specimens recovered from *Larus ridibundus* were allowed to develop at room temperature in water, and after about 7 days larvæ appeared. By the tenth day they had undergone ecdysis, the cast skin being retained as a sheath around each larva. Hatching commenced about 3 days later and continued for nearly 2 months. The larvæ both before and after hatching remained almost motionless and showed no migratory tendencies. In the first experiment approximately 150 eggs and larvæ which had undergone development for 30 days were administered to each of 4 one-month-old chickens. They were examined for helminths after 21–28 days, but none were found.

As the known hosts of *Cyathostoma lari* consume earthworms, *Lumbricus terrestris* was selected as a trial intermediate host for the second experiment. The earthworms were placed in sterilized soil enclosed in a polythene bag to reduce evaporation. About 50 *Cyathostoma* eggs which had developed for 23 days were pipetted into the gut of each of 22 earthworms. After 3 weeks the worms were fed to 11 three-week-old chickens, whilst a further 2 birds received eggs and larvæ direct. The birds were killed 21–28 days later. One adult female *C. lari* containing apparently maturing eggs was recovered from the orbital sinus of a bird which had received earthworms. No helminths were found in any of the other birds.

The life-cycle had thus been carried out experimentally in 54 days after recovering fertile eggs from the original female. While the shortest time required for completion of the life-cycle has not been established, it may well be less than this as Romanova[4] found that *Cyathostoma* sp. in the trachea of the emu reached sexual maturity in 21–28 days.

Cyathostoma lari has never been recorded from domestic chickens, and although the experiments reported here were only partially successful they demonstrate that the domestic fowl can be infested, perhaps only at an early age. Further work is necessary to elucidate the complete life-cycle of *C. lari*, which may be similar to that of its close relative, the gapeworm *Syngamus tracheæ*; that is, direct from bird to bird of the same species but requiring an intercalary host for transmission from wild birds to domestic poultry[5].

R. T. Pemberton

Department of Zoology,
The University,
Leeds, 2.
June 1.

[1] Chapin, E. A., *J. Agric. Res.*, **30** (6), 557 (1925).
[2] Cram, E. B., *Bull. U.S. Nat. Mus.*, **140**, 1 (1927).
[3] Burt, D. R. R., and Eadie, J. M., *J. Linn. Soc.* (Zool.), **43**, (293) 575 (1958).
[4] Romanova, N. P., *Proc. Moscow Zool. Park*, **3**, 136 (1946).
[5] Clapham, P. A., *J. Helminth.*, **13** (1), 1 (1935).