that found for more complex molecules. This may be due to the unusually large forces between the molecules of hydrogen and helium due to the presence of two electrons only in the outer shell; in most other substances the outer shell of each atom contains eight electrons and the intermolecular forces are correspondingly modified. Hence the parachor, in which some attempt is made to allow for the effect of internal pressure on the volume occupied by a gram-molecule of a liquid gives a rather better parallelism with the viscosity data than does the critical volume. The uncertainties involved in the data and in the hypotheses used in the calculation of diameters are large and must be borne in mind when attempting to interpret the ratios given in the last column of the table. The abnormality of the critical volumes of hydrogen and helium is, however, so great that I think it must be regarded as real.

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A Method of obtaining Stages in the Life-history of the Liver Fluke for Class Purposes.

THE life-history of the liver fluke (*Fasciola hepatica*) was described by A. P. Thomas in *Q.J.M.S.*, Lond., vol. 23, N.S., 1883. He succeeded in rearing experimentally the early stages of the complicated life-history of this parasite by collecting eggs from the gall bladder of sheep, bringing about their hatching under suitable conditions, and infecting the molluscan host, *Limnæus truncatulus*, from which he obtained both rediæ and cercariæ, using the latter for the infection of young lambs. His methods, however, are not suitable for class demonstration owing to the difficulty nowadays of getting the eggs of the fluke from heavily infected sheep.

During the past two years I have used a simpler method. It is generally possible to obtain from the local abattoir a few specimens of adult flukes either alive or dead. The flukes should be washed free from bile and mucus. Each specimen is then dissected under the Zeiss binocular dissecting microscope and the contents of the uterus emptied into a flat-bottomed watch glass. Some of the eggs will be yellow in colour and are suitable for hatching experiments, others are white and should be discarded. The yellow eggs sink to the bottom of the water, and when a sufficient number have been extracted, the fluke tissues and clouded water are pipetted off. Repeated washing leaves the eggs in a clear fluid. The development of the eggs can be studied under the microscope from day to day. Every few days the water should be changed. Warning of the hatching of the eggs is given by the appearance of cilia and of the X-shaped eye spot. At first the young embryo squirms up and down within the egg shell, but about the last day before hatching it turns round as if trying to find the exit. The period of development varies with the temperature; in spring it is about a month, but is less in warmer weather. The eggs hatch in batches in the morning and the larvæ are phototropic. By the same evening all are dead unless they have found a host.

As soon as possible after hatching, a specimen of *Limnæus truncatulus* is introduced into the dish. In a short time it acts as a focus around which the miracidia swarm. The actual penetration can be watched under the Zeiss binocular. Large numbers of the larvæ fix themselves to the tentacles, head, and mantle of the snail, so that the unfortunate and apparently unconscious mollusc is bristling with white threads, which show up well against its dark skin. As many as sixty were counted on one snail, and this does not include those which entered the pulmonary chamber and were lost to view. The larvæ bore like screws, and take from fifteen minutes to an hour or more to disappear within the snail.

Specimens of *Limnæus* preserved at this period and afterwards sectioned show the miracidia entering the body, while snails killed after an interval of two or three weeks exhibit the sporocyst and redia stages. Many of the miracidia do not develop; Thomas says they must enter the pulmonary chamber or body cavity and that they do not develop in the foot. I have, however, found them in the kidney, dorsal body wall of the head and sides of the foot. Thomas also states that few snails survive three weeks of artificial infection, but I have had no deaths as the result of infection, however heavy. Snails were infected this year on Mar. 11, and are still alive and active.

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Parasitism in Relation to Pupation in *Lucilia sericata* Meig.

IN NATURE of April 19, p. 598, Holdaway and Evans make reference to the stage in which the hibernation of *Lucilia sericata* Meig. takes place. Their observations show that although "both larvæ and puparia were recovered from the soil surrounding baits exposed in the autumn and examined towards the end of the season", that 87·4 to 92·2 per cent of these puparia (plus larvæ pupated within eight days of collection) were parasitised. From these facts it is evident that in Toulouse, France, from which station the letter is addressed, the normal mode of hibernation of *Lucilia sericata, excluding the influence of parasitism*, is in the larval stage, and thus is similar to that found by me in North Wales in 1928–1929 (NATURE, May 18, 1929, vol. 123, p. 759). In the latter case, and again last winter, when observations on the hibernation of *Lucilia sericata* have been confirmed, not a single puparium appeared among the hibernating larvæ.

This fact at first appears striking, since Holdaway and Evans found hibernating puparia which did not yield parasites. It should, however, be noted that I was dealing with larvæ obtained direct from living sheep, and not with larvæ from exposed baits as was the case in the work of Holdaway and Evans. It proved very significant that from the 5622 larvæ obtained periodically from living sheep during the survey in the summer 1928, and from the many batches of larvæ obtained from similar sources throughout the summer 1929, no parasite was bred. This fact no doubt explains the absence of stimulated pupation among the hibernating larvæ, and thus, as negative evidence, supports the observations of Holdaway and Evans that pupation among hibernating larvæ is stimulated by parasitism.

Further, the complete absence of puparia among these non-parasitised hibernating larvæ upholds the view that in the observations of Holdaway and Evans the puparia present which did not yield parasites had been previously stimulated to pupate by a secretion or other factor operative during the oviposition of the parasite, which oviposition had been non-productive.

The absence, or the extraordinary rare occurrence, of parasitism among larvæ of *Lucilia sericata* obtained from the living host will, no doubt, prove an important factor in the success of *Alysia manducator* Panz. in the biological control of blow-flies. The living sheep will obviously be a constant and important source of unparasitised larvæ. The reason for this immunity cannot be the absence of the parasite from the