I - INTRODUCTION

An increasing amount of attention is being paid at present to insect embryology which provides a fascinating study of the origin and development of various anatomical structures that are seen in the adult insects. A worker, in the course of his investigations, also comes across such points which go to suggest inter-relations amongst diverse groups of insects as well as their relationship with the ancestral forms. Research on insect embryology can be traced back to the early 19th century, perhaps the work of Suckow (1818) on Bombyx mori being the earliest published account of the development of an insect. It should, however, be borne in mind that these earlier studies were based on the examination of whole mounts and did not convey any idea of the potentialities of cells which go to make an organism.

With the invention of the microtome a great advance was made in the realm of descriptive embryology and a large number of valuable papers were published. Today with the latest techniques of fixation and sectioning one can build up a fairly complete picture of the important changes that take place inside the developing egg. However, there are problems like cell migration and cell lineage which still await further research on the experimental side to bring to light facts which hitherto have been the cause of much controversial interpretation.
A considerable amount of work has been done on several Orders of insects particularly Orthoptera, Lepidoptera, Diptera and Coleoptera, but the insects belonging to the Order Hymenoptera have received relatively little attention. Mostly the honey bee has been made a subject of wide investigation, important works in this connection being those of Metschnikoff (1866) and Grassi (1884). Later on, Nelson (1915) published his classical work on the embryology of this insect. Besides these works on the honey bee, the only paper that deserves special mention is that of Carrière and Bürger (1897) on the embryology of the mason bee *Chalicodoma muraria* Fabr. In addition to these contributions, work has also been done on the parasitic Hymenoptera, important papers being those of Leiby (1922) on *Copidosoma gelechiae* and of Leiby and Hill (1923) on *Platygastrer higemalis*.

Among the lower Hymenoptera the family Tenthredinidae comprises a group of insects which are primitive in comparison to the higher Hymenoptera and as such their importance cannot be over-looked. The literature so far available records only a few papers on the embryonic development of the sawflies. The account of Graber (1890) is brief and deals mainly with the external features of the embryos of the barberry sawfly *Hylotoma berberidae*. Doncaster (1906) studied the maturation of the unfertilized egg and the fate of the polar bodies in the Tenthredinidae. The only paper that makes a definite improvement in our knowledge is a
recent paper of Shafiq (1954) on the embryology of the gooseberry sawfly *Pteronidea ribesii*.

All the papers mentioned above give only an incomplete picture of the embryonic development of sawflies. The present work, therefore, was undertaken with a view to provide a reasonably comprehensive account of the embryology of a Tenthredinid so that material may be made available for comparing the development of the sawfly with the higher Hymenoptera and other insects.

The Indian Mustard sawfly *Athalia proxima klug* was selected as a type for its great economic importance. In North India it is abundantly found during the monsoon months and its larvae are a source of considerable damage to the cruciferous plants particularly radish.

The text embodies a fairly complete account of the early development of the egg and a detailed account of the organogeny. Certain problems of insect embryology, such as gastrulation, segmentation of the head and the origin of the mid-gut epithelium are highly disputed and a great deal has been said about them in the past. In the present work due attention has been paid to these special problems and an attempt has been made to give a conclusive opinion wherever possible. The origin of the mesoderm has been described in detail and the development of mesodermal organs has been adequately dealt with. External changes in the form of the egg have also been given so that they could help in a better appreciation of the corresponding
internal changes. A bipolar origin of the mid-gut has been advocated and the development of the alimentary canal has been described up to the stage when the larval form becomes recognizable. The rudiments of the dorsal vessel, the body cavity and the associated structures have been critically studied and their development has been followed up to the time when these structures become well defined. The literature so far available provides only a very brief account of the nervous system of sawflies. Particular attention was, therefore, paid to give details of the development of the nerve cord, the brain including the optic ganglion and the sympathetic nervous system. An interesting feature in *A. proxima* is the occurrence of the pole cells. These primordia of germ cells, as far as the knowledge of the writer goes, have not been described previously in any member of the non-parasitic Hymenoptera. Their migration and final transformation into gonads has been studied.