CHAPTER VI.

Polymerization in Callocephalidae analis F. (Coleoptera, Bruchidae) and its occurrence of the Aedeagus correlated with it.

INDEX

I. Introduction  114
II. Material and methods  115
III. Observations  117
IV. Discussion  120
V. Abstract  123
VI. Key to the lettering of figures  128
CHAPTER VI

Polymorphism in Callosobruchus analis F. (Coleoptera, Bruchidae) and 'Retournement' of the Sedeagus correlated with it.

I INTRODUCTION

Arora and Pajni (1959) described a 'sterile' strain in Callosobruchus analis. This situation is obviously comparable to occurrence of 'active' individuals in Callosobruchus maculatus (Utida, 1954; Southgate et al., 1958; Caswell, 1960).

Pawar and Verma (1977) noted that in a March population of C. analis about 50% of individuals showed the morphological effects of a clockwise 'retournement' of the sedeagus and the remaining 50% of an anticlockwise 'retournement'. Possibility of a correlation between the direction of 'retournement' and the polymorphism, i.e., occurrence of normal and 'sterile' individuals, which are morphologically distinguishable, occurred to us. Investigations have led to inference of a definite correlation between the two, as detailed in our 'Observations'.
("Retournement" of the aedeagus, a term from Jeannel, 1955, is a rotation of the organ during development. It leads to a twisted nervous and tracheal supply for the organ, Verma, 1969; Kumar and Verma, 1971. The turning of the aedeagus is brought about by disappearance of a muscle whose counterpart of the opposite side survives as the functional protractor of the spiculum and exerts on the dorsal surface of the aedeagus a unilateral pull, Verma, 1969; Verma and Kumar, 1972. The twisted and asymmetric nature of the tracheal and nervous supply and often the asymmetric orientation of the functional protractor of the spiculum indicate direction of 'retournement', whether clockwise or anticlockwise.)

II. MATERIAL AND METHODS:

A culture of C. anulis was developed from collections made at Betul (Madhya Pradesh). This culture has been maintained since then. All the material for the present study was derived from this culture. Specimens were examined for external features and were dissected under magnification. In all cases fresh material was dissected.
For getting adults of a desired age, mature larvae were 'dissected' out from seeds and were kept on a thin layer of gram flour in patri-dishes. Through its movements each larva made a hemispherical depression for itself on surface of the flour. It pupated within the depression. Soon after pupation the insects were removed to another patridish with a layer of cotton-wool. On imaginal moult a very thin coat is cast off and collects in a much crumpled form along the mid-ventral line of the abdomen and eventually collects at the posterior end. The age of the adult was calculated by counting hours from the time the cast-skin was seen accumulated on the mid-ventral line of the abdomen.

For comparing corpus allatum size in normal and 'sterile' individuals, heads of such individuals were separated, fixed, doubly embedded in celloidin and paraffin and were serially sectioned. Care was taken to section the different heads in nearly the same plane. The largest sections of the two corpora allata of each specimen were sketched on a graph paper, and the area of the section of each c.allatum was worked out. Extent of magnification was not taken into account, as the aim was to compare the size of the gland in the two variation,
Overoiles were observed to be incompletely developed in females of the category 'B', and they showed fewer eggs in their calyces than those of the category 'A'. (In the category 'A' the calyx of each side showed 9 to 9 eggs, while the number for 'B' was 4 to 5 eggs). The category 'B' is obviously comparable to the 'active forms of *C. cumulans* (Caswell, 1930). In the female reproductive system of 'B' the bursa was found to be specially enlarged (fig. 35, 36). In females of in category 'C' the development of the reproductive organs including that of the bursa was as described above for the category 'B'.

In addition to those included in the category 'C' other individuals with mixed features were also seen. Such individuals, including those of the category 'C', seem to be transitory between the categories 'A' and 'B'.

Males of the categories 'A', 'B' and 'C', were carefully dissected and examined for the aedeagal muscles and for the tracheal and nervous supplies for the aedeagus to infer the direction of 'retournement' (54 males of 'A', 33 of 'B', and 31 of 'C'). It was found that the direction was invariably clockwise in males of the category 'A', (fig. 87) and anticlockwise in those of the category 'B' (fig. 88) and 'C'.

In an experimental study on the Chrysomelid *Aspidomorpha* (Kumar and Verma, 1978) it was inferred that delayed restart of secretion by the c. allata in the adult resulted in an anticlockwise 'retournement'. Observations of Gill and Bawa (1971) on *Callosobruchus maculatus* also suggest delayed activation of c. allata in the abnormal individuals of this species. Hence the following approach was planned.

It had been observed that at 24 hours after shedding of the pupal skin the process of 'retournement' was in progress in *c. analis* (a similar situation, i.e. the 'retournement' taking place in a young adult, has been described in *Aspidomorpha*, Verma and Kumar, 1972). Such young adults were dissected and examined. It was found that in some 24 hour old adults the 'retournement' was clockwise and considerably advanced in it was anticlockwise and incipient. These observations obviously support the notion expressed in the previous paragraph.

Heads of 24-hour-old males showing clockwise 'retournement' in progress, and of those of this age, either showing no 'retournement' or showing beginning of anticlockwise 'retournement' were separately fixed and serially sections.
(The first type of individuals were presumably of the category 'A' and those of the second type of 'B' and 'C'). The sizes of the c. allata in the two types of males were compared by the method described under 'Material and Methods' above. Average area of the largest section of a gland for five males of the first type was found to be 666 sq. mm. in a magnified form, and the corresponding value for five males of the second type 455 sq. mm. at the same magnification. Thus there is a significant difference in size of the glands in the two types of young males.

IV. DISCUSSION:

The description of body colouration in normal and 'sterile' individuals in C. analis by Arora and Pajni (1959) does not agree any considerably with the observations recorded in the present communication. Moreover it is doubtful if these authors studied C. analis (Arora et al. 1969 say that the study by Arora and Pajni, 1959 was actually related to C. maculatus).

Arora and Pajni (1959) and also Raina (1970) point out that females are a little darker than males in C. analis. No such difference between the two sexes, either among normal or 'sterile'
individually could be found in the present study.

There is a definite polymorphism in *C. analis*; the morphs or types described above as 'A', 'B' and 'C' are externally distinguishable by their body colouration.

Direction of the phenomenon of 'retournement' of the aedeagus shows a definite correlation with the polymorphism in *C. analis*. It is clockwise, when seen from behind in the type 'A' and anticlockwise in 'B' and 'C'. As has been pointed out by Verma (1959), the direction of 'retournement' in all those coleoptera, in which the phenomenon has been described and the direction has been mentioned, is clockwise. In some Cassidinae anticlockwise 'retournement' may be found as an exceptional condition (Verma and Kumar, 1972). As has been mentioned above also, an endocrine control of direction of 'retournement' of the aedeagus has been discovered in the Chrysomelidae, *Aspidomorpha* (Kumar and Verma 1973). Delayed restart of C. allatum secretion in *Aspidomorpha* leads to an anticlockwise 'retournement'. This theory finds a good support in the present study. The observations that in those males of *C. analis*, in which 'retournement' of the aedeagus is clockwise, the phenomenon occurs earlier than in
those in which it is anticlockwise, and that in young males, showing clockwise 'retournement' in progress the corpora allata are larger than in those, in which 'retournement' has not yet started or is incipient and anticlockwise, fall in line very well with the above pointed theory of endocrine control of direction of the 'retournement'. Relative inactivity of ovaries in females of the categories 'B' and 'C' in C. analis and delayed development of the male accessory glands in 'sterile' individuals of C. maculatus (Cili et al., 1971) also suggest relative inactivity of C. allata in the young adults of the abnormal Bruchid individuals. That there is a relation between skin pigmentation and C. allata activity is now known in several instances (Stall, 1961 in locusta; Bagley and Bauernfeind, 1972 in the tobacco hornworm Manduca sexta; Dakahayani and Mathad, 1977 in the cricket Gryllos bimaculatus, and Yaragamblinath and Mathad, 1978 in the cricket Gryllodes sigillatus). In the last four of these studies extra-activity of JH has been found to lead to diluted skin pigmentation. That in C. analis individuals of the category 'A' are less deeply pigmented than those of 'B' and 'C' agrees well with these studies.
Thus, the polymorphism in *Callosobruchus analis* seems to be due to JH. Polymorphism controlled by JH is known in a number of insects (Novák, 1975). Experimental studies by Staal (1961) on *Locusta* and by Wirtz (1973) on the honey bee are specially notable in this context. On basis of available facts it can be taken as fairly well established that polymorphism in developmental stages and adults of Insects is due to JH (de Wilde and Wirtz, 1974).

V. ABSTRACT

Polymorphism in *Callosobruchus analis* has been described. Individuals are distinguishable into three categories, 'A', 'B' and 'C' by their body colouration. Individuals of the categories 'B' and 'C' are relatively sterile, as indicated by their incompletely developed ovaries. 'Retournement' of the aedeagus is clockwise in males of 'A', but invariably anticlockwise in 'B' and 'C'. In young males of the former type the corpora allata are larger in size than in those of the latter two types. On basis of this and other available facts it has been inferred that production of the categories 'B' and 'C' is due to relative inactivity of C. allata.
VI  KEY TO LETTERING OF FIGURES

ASP2  =  Second spiculum.
AV   =  Anogenital vestibule.
BC   =  Bursa copulatrix
GL   =  Calyx.
GL   =  Last abdominal ganglion.
MB   =  Basal muscular bulb.
MED  =  Median ejaculatory duct.
MP   =  Median tract of white pubescence on the pygidium.
NAL  =  Aedeagal nerve of the left side.
NAR  =  Aedeagal nerve of the right side.
W    =  Ovarioles.
PL   =  Parameral lobes.
PSP1 =  Protractor of first spiculum
RE   =  Rectum.
SPG  =  Spermathecal gland.
SP2  =  Second spiculum.
TAL  =  Trachea/ tracheae arising on the left side and supplying in aedeagus.
TAR  =  Trachea/ tracheae arising on the right side and supplying the aedeagus.
VA   =  Vagina.
VII, VIII, IX = abdominal terga of seventh, eighth, and ninth abdominal segments.

3 to 8 = Abdominal sterna.
**Figure 79.** Pygidium of *Callosobruchus analis*, category 'A', dorsal view.

**Figure 80.** Ventral view of abdomen of *C. analis*, category 'A'.
Figure 51. - Pygidium of *C. analis*,
category 'B', dorsal view.

Figure 52. - Ventral view of abdomen
of *C. analis*, category 'B'.
Figure 83. - Pygidium of C. analis, category 'C', dorsal view.

Figure 84. - Ventral view of abdomen of C. analis, category 'C'.
Female reproductive organs of *Cantharellus* category 'A', dissection from the ventral side.

Female reproductive organs of *Cantharellus* category 'B', dissection from the ventral side.
Male, *C. analis*, category 'A', dissected from the ventral side. Aedeagal tracheae, nerves and asymmetric protractor of the first spiculum indicate clockwise 'retournement'.

Male, *C. analis*, category 'B', dissected from the ventral side. Aedeagal tracheae, nerves, and asymmetric protractor of the first spiculum indicate antilelock-wise 'retournement'.

**

(EB: - Scale accompanying each figure denotes 1. m.m.)