OBSERVATIONS

Cytogenetically, coreids like other heteropterans, are characterized by possession of holokinetic chromosomes (i.e. without a localized centromere), a pair of microchromosomes and post-reductional meiosis for sex chromosomes. Besides, they possess a pair of microchromosomes and lack Y chromosome. Being holokinetic, chromosomes lack any primary constriction and appear either rounded or rod-shaped at mitotic metaphase. During anaphase, chromatids remain parallel to the axis of division and at right angle to the spindle fibres. In few heteropterans, kinetic activity is restricted to the telomeric regions and chromatids appear V-shaped during anaphase. Microchromosomes remain usually unpaired during early meiosis I and thus are achiasmatic. By late diakinesis, they come closer and associate together end to end forming a pseudobivalent (m-pseudobivalent) at metaphase I which segregates reductionally during anaphase I. The second meiotic division is equational for them.

Meiosis in Coreidae is characterized by the presence of a diffuse stage which follows pachytene. During this stage, the nucleus recedes towards a condition of resting stage. Autosomal bivalents decondense while sex chromosomes condense to form a darkly stained heteropyknotic body. In case of multiple sex chromosomes, all the X chromosomes remain closely associated or fused during the diffuse stage. During diplotene, autosomal bivalents recondense and show chiasmata while microchromosomes and sex chromosomes remain achiasmatic. A typical pattern of chromosome arrangement is observed at metaphase I and II in Coreidae. During anaphase I, autosomes and microchromosomes divide reductionally while sex chromosome/s divide equationally. Anaphase II is equational for autosomes and microchromosomes while reductional for sex chromosomes as a result of which, two types of nuclei are formed at telophase II, one having X and the other lacking it.
In the present study, diploid chromosome complements and course of meiosis of 23 coreid species belonging to 2 subfamilies referable to 8 tribes have been described. C-banding and fluorescent banding pattern has been described for 20 and 19 species respectively. Nucleolar behavior has been studied in 10 species. The results are described for each species as follows:

**SUBFAMILY: COREINAE**

(i) Tribe: Mictini

1. *Anoplocnemis compressa* (Dallas, 1852)

   *(Photograph-1)*

   Prometaphase stage of *Anoplocnemis compressa* reveals fifteen elements which include fourteen autosomes and sex chromosomes, X (Fig. 1). Two pairs of autosomes are distinctly larger than rest of the five pairs, X being equal to the smallest autosome. The total diploid complement length is 54.36µm (Table).

   **Table: Metrical analysis of chromosomes of *Anoplocnemis compressa***

   *(2n=15=14A+X0)*

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3   4  5  6  7</td>
<td></td>
</tr>
<tr>
<td>Length (µm)</td>
<td>7.5 5.29 4.11 2.94 2.35 2.35 1.76</td>
<td>1.76</td>
</tr>
</tbody>
</table>

   Total Diploid Complement Length = 54.36µm

   At diffuse stage, X chromosome appears as a single darkly stained body. Besides two or three heteropycnotic regions are also seen (Fig. 2). At diplotene, two
Observations

large autosomal bivalents show one or two chiasmata which can be terminal, sub-terminal or interstitial or one single terminal chiasma while smaller autosomal bivalents show single chiasma each which is terminal, sub-terminal or interstitial (Figs. 3, 4, 13, 16). A similar condition is observed at diakinesis (Fig. 5).

At metaphase I, all the seven autosomal bivalents arrange themselves in a ring. X lies outside far away from the ring seen both in side and polar view (Figs. 6, 7). Anaphase I reveals reductional division of autosomes and equational division of sex chromosomes. X is seen moving towards both the poles (Fig. 8).

At metaphase II, autosomes form roughly a ring and X lies away from the autosomal group. In the side view, X is seen towards one of the pole (Figs. 9, 10).

Anaphase II is equational for autosomes and reductional for sex chromosomes. X body acts as a laggard and is added passively to one of the poles. At telophase II, two types of nuclei are formed one with n=7A+X and the other with n=7A+0 (Fig. 11).

C-banding

At diffuse stage, apart from darkly stained sex chromatin, numerous C-positive regions are also observed. At diplotene, X is positively heterochromatic. All the autosomal bivalents show C-bands at one or both terminal ends (Figs. 12, 13).

Fluorescent banding

X is DAPI and CMA₃ bright at diffuse stage as well as diplotene. All the C-positive regions appear DAPI and CMA₃ bright (Figs. 14-17).

Ag-NOR banding

Four nucleolar bodies are observed at interphase. At diplotene, NORs are found to be associated with all the autosomal bivalents (Figs. 18, 19).
2. *Anoplocnemis phasiana* Fabricius, 1781

(Photograph-2)

The male diploid chromosome complement of *Anoplocnemis phasiana*, as revealed by spermatogonial metaphase plate, is comprised of fifteen elements which include fourteen autosomes and sex chromosome, X (Fig. 20). Autosomes can be placed in two groups based on their sizes. Two pairs of autosomes are extremely large in size (6.14µm and 5.42µm) than rest of the five pairs which show regular gradation in size ranging from 2.57µm to 1.42µm. X (1.42µm) is equal in size to the smallest autosome. The total diploid complement length is 44.22µm (Table).

**Table: Metrical analysis of chromosomes of *Anoplocnemis phasiana***

(2n=15=14A+X0)

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Sex chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td>X</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>6.14 5.42 2.57 2.14 2.14 1.57 1.42</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 44.22µm

During the diffuse stage, autosomes appear highly decondensed while condensed X forms a heteropycnotic body lying on the nuclear periphery (Fig. 21). At diplotene, two large autosomal bivalents show one or two chiasmata each which may be terminal, subterminal or interstitial while small autosomal bivalents show one terminal, subterminal or interstitial chiasma each (Figs. 22-24, 32). Chromosomes condense further at diakinesis. X chromosome appears distinctly bipartite (Figs. 25, 26).
At metaphase I, autosomal bivalents form a ring with X lying outside the ring (Fig. 27). Telophase I reveals reductional division of autosomes and equational division of sex chromosome as X can be seen lying outside the autosomal group at both the poles (Fig. 28).

Arrangement of chromosomes at metaphase II could not be recorded as polar view plates were not found (Fig. 29). During anaphase II, reductionally dividing X can be seen moving as a laggard towards one of the poles (Fig. 30).

**C-banding**

X chromosome is positively heterochromatic at diffuse stage with a thick terminal band. At diplotene, large autosomal bivalent shows C-positive bands on both ends. Rest of the small autosomal bivalents show terminal C-positive regions. X chromosome shows terminal C-positive region (Figs. 31, 32).

**Ag-NOR banding**

One nucleolar body is observed at interphase. At diplotene, NORs are found to be associated with all the autosomal bivalents (Figs. 33, 34).

### 3. *Anoplocnemis binotata* Distant, 1918

*(Photograph-3)*

As revealed by spermatogonial metaphase, the diploid chromosome complement of *Anoplocnemis binotata* is comprised of fifteen elements which include fourteen autosomes and sex chromosome, X (Fig. 35). Hence, the complement is \(2n=15=14A+X0\). Two pairs of chromosomes (7.40µm and 5.10µm) are distinctly large while rest of the five pairs are small ranging from 3.19µm to 2.55µm. X (2.12µm) is the smallest element. The total diploid complement length is 55.60µm (Table).
Table: Metrical analysis of chromosomes of *Anoplocnemis binotata*

*(2n=15=14A+X0)*

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (µm)</td>
<td>7.40</td>
<td>5.10</td>
<td>3.19</td>
<td>3.19</td>
<td>2.76</td>
<td>2.55</td>
<td>2.55</td>
<td>2.12</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length = 55.60µm

During the diffuse stage, X forms a darkly stained heteropycnotic body which lies on the periphery of highly decondensed autosomes (Fig. 36). At diplotene, five small autosomal bivalents show single chiasma each. The large two bivalents show one or two chiasmata each which are terminal, sub-terminal and interstitial (Figs. 37, 38). Diakinesis shows further condensation of chromosomes (Fig. 39).

At metaphase I, autosomal bivalents form a ring with X lying outside the ring (Fig. 40). Anaphase I is reductional for autosomes and equational for sex chromosomes (Fig. 41). At metaphase II, autosomes and X show a peripheral arrangement forming a ring (Fig. 42).

Anaphase II is equational for autosomes and reductional for sex chromosomes. X chromosome lags behind the autosomes and is added to one of the poles (Fig. 43). So that, two types of nuclei are produced, one with 7A+X and the other with 7A+0 (Fig. 44).

C-bandng

X chromosome is positively stained at the diffuse stage for C-banding. One of the small autosome shows thick bands. Rest of the autosomal bivalents show thin terminal and interstitial bands. X is C-negative (Figs. 45, 46).
Fluorescent banding

At diffuse stage, X chromosome is positive to both DAPI and CMA₃. At diplotene, X chromosome is negative to both DAPI and CMA₃ whereas autosomes appear positive to both the stains (Figs. 47-50).

4. *Ochrochira nigrorufa* (Walker, 1871)

(Photograph-4)

As revealed by spermatogonial metaphase plate, the male diploid chromosome complement of *Ochrochira nigrorufa* comprises twenty one elements which include eighteen autosomes, a pair of microchromosomes and a sex chromosome, X (Fig. 51). Autosomes show gradation of size ranging from 3.57µm to 2.14µm. Microchromosomes are smaller than the autosomes (2.00µm) and X chromosome is the shortest element of the complement (1.14µm). The total diploid complement length is 53.34µm (Table).

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>3.57</td>
<td>3.42</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 53.34µm

At the diffuse stage, darkly stained X chromosome lies on the periphery of partially decondensed autosomes (Fig. 52). During diplotene, all the autosomal bivalents show one chiasma each which may be terminal or sub-terminal. X
chromosome and microchromosomes appear distinctly bipartite (Fig. 53). Microchromosomes are comparatively larger than observed in other coreids and can be visualized throughout the course of meiosis. Chromosomes appear condensed further at diakinesis. Microchromosomes still lie far apart (Fig. 54).

At metaphase I, autosomal bivalents form a ring with m-pseudobivalent lying in the centre and X lying outside the ring (Fig. 55). During anaphase I, autosomes and microchromosomes divide reductionally while X divides equationally (Fig. 56). At metaphase II, autosomes roughly form a ring with microchromosome lying within the ring and X chromosome lying outside the ring (Fig. 57). Anaphase II is equational for autosomes and microchromosomes while reductional for sex chromosome. Hence, two sets of chromosomes formed at opposite poles are of \( n=9A+m+X \) and \( n=9A+m+0 \) types (Fig. 58).

**C-banding**

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes show heavy interstitial C-bands while all autosomal bivalents show heavy terminal and interstitial C-bands (Figs. 59, 60).

**Fluorescent banding**

Fluorescent banding pattern with DAPI and CMA\(_3\) corresponds completely with C-banding. At diffuse stage, X chromosome is both DAPI and CMA\(_3\) positive. Autosomal bivalents also show overlapping DAPI and CMA\(_3\) positive C signals. Microchromosomes show heavy interstitial signals bright with both DAPI and CMA\(_3\) (Figs. 61-64).
5. **Ochrochira aberrans** (Distant, 1889)

*(Photograph-5)*

The male diploid chromosome complement of *Ochrochira aberrans* is comprised of nine pairs of autosomes, two microchromosomes and sex chromosome, X \((2n=9AA+2m+X0)\). As depicted in diplotene and metaphase plates, autosomes show only slight gradation in size (Figs. 66, 68). Microchromosomes are quite large in size but are smaller than the autosomes. Being larger in size, they can be visualized throughout the course of meiosis.

Diffuse stage reveals darkly stained X chromosome lying against decondensed autosomes (Fig. 65). At diplotene, all the autosomal bivalents show single chiasma each which is terminal or sub-terminal. Microchromosomes appear constricted and lie well apart till diakinesis (Figs. 66, 67). At metaphase I, autosomal bivalents form a ring with m-pseudobivalent lying in the centre. X lies slightly outside the ring of autosomal bivalents (Fig. 68). Anaphase I is reductional for autosomes and microchromosomes while equational for sex chromosomes (Fig. 69). During anaphase II, X divides reductionally and moves as a laggard towards one of the poles (Fig. 70).

6. **Prionolomia** sp.

As revealed by spermatogonial metaphase plate, the male diploid complement of *Prionolomia* sp. is \(2n=27\) (Fig. 71). The complement comprises twelve pairs of autosomes, a pair of microchromosomes and a sex chromosome, X. Autosomes can be placed in three groups based on their sizes. One pair of autosomes (2.85µm) is distinctly larger than the rest. In the second group come seven pairs of autosomes which show regular gradation in size ranging from 2.00µm to 1.42µm. In the third group, four pairs of small autosomes fall (1.14µm to 1.00µm). Microchromosomes
Observations

(0.85) are the smallest elements of the complement. X chromosome (1.28µm) is bigger than autosomes of the third group. The total diploid complement length is 41.18µm (Table).

Table: Metrical analysis of chromosomes of *Prionolomia* sp.

\[(2n=27=24A+2m+X0)\]

<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Autosomes</th>
<th>Microchromosome</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.85</td>
<td>1.71</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>2.00</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.85</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1.85</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.71</td>
<td>1.42</td>
<td></td>
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<td>6</td>
<td>1.71</td>
<td>1.14</td>
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<td>7</td>
<td>1.57</td>
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<tr>
<td>8</td>
<td>1.42</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>1.14</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1.00</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1.00</td>
<td>1.28</td>
<td></td>
</tr>
</tbody>
</table>

Total Complement Length (TCL) = 41.18m

At the diffuse stage, darkly stained heteropycnotic X chromosome is seen lying against highly decondensed autosomes (Fig. 72). At diplotene, autosomal bivalents show single chiasma per bivalent which may be terminal or sub-terminal. Microchromosomes are faintly stained and lie far apart (Fig. 73). As division proceeds towards diakinesis, chromosomes condense further. Microchromosomes come close to each other (Fig. 74).

Metaphase I reveals a regular arrangement of chromosomes wherein all the nine autosomal bivalents form a ring with m-pseudobivalent lying within the ring and X lying outside the ring (Fig. 75). During anaphase I, autosomes and microchromosomes divide reductionally while sex chromosome divides equationally (Fig. 76). At metaphase II, autosomes and microchromosomes are roughly arranged to form a compact ring while X chromosome lies away from the ring (Fig. 77). The X
chromosome divides reductionally during the second meiotic division as a result of which it moves as a laggard to one of the poles during anaphase II (Fig. 78).

C-banding

At diffuse stage, condensed X chromosome appears completely C-negative. The largest autosomal bivalent shows two conspicuous terminal bands which are evident at diffuse stage as well as diplotene. Rest eleven autosomal bivalents are completely C-negative (Figs. 79-81).

Fluorescent banding

At diffuse stage, X chromosome is DAPI bright but weakly positive for CMA3. In addition, two bright DAPI and CMA3 signals are seen on the diffused autosomal bivalents with a few small CMA3 signals. During diplotene, X is negative to both DAPI and CMA3. As evident in C-banding, the largest autosomal bivalent shows two terminally bright DAPI and CMA3 signals during diplotene as well as diakinesis (Figs. 82-85).

Ag-NOR banding

One nucleolar body is observed at interphase (Fig. 86).

ii) Tribe: Gonocerini

7. *Cletus punctiger* (Dallas, 1852)

(Photograph-6)

As revealed by spermatogonial metaphase, the diploid chromosomal complement of *Cletus punctiger* is 2n=18 (Fig. 87). The complement is comprised of seven pairs of autosomes, two microchromosomes and two sex chromosomes, X1 and X2. The autosomes can be arranged into two groups depending on size differences: two pairs of extremely large (4.70µm) and five pairs of small autosomes (2.20µm to
Observations

2.00µm). \(X_1\) (1.47µm) and \(X_2\) (1.17) are slightly unequal in size. Microchromosomes (0.58µm) are the smallest elements of the complement. The total diploid complement length is 43.00µm (Table).

**Table: Metrical analysis of chromosomes of **Cletus punctiger**

\(2n=18=14A+2m+X_1X_20\)

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome</th>
<th>Sex chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2   3  4  5  6  7</td>
<td>(m)</td>
<td>(X_1)</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>4.70 4.70 2.20 2.00 2.00 2.00</td>
<td>0.58</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 43.00µm

During the diffuse stage, a single darkly stained heteropycnotic body representing fused \(X_1X_2\) lies on the periphery of partially decondensed autosomes (Fig. 88). During diplotene, two large autosomal bivalents show two terminal chiasmata forming ring bivalents. As diplotene proceeds, variations with respect to position, number and terminalisation of chiasmata have been observed. Most commonly, one of the extremely large autosomal bivalents shows single terminal or sub-terminal chiasma. The other large bivalent shows two terminal chiasmata or one terminal and the other interstitial chiasma or single terminal, sub-terminal or interstitial chiasma. \(X_1\) and \(X_2\) lie closely associated. Microchromosomes are placed far apart (Figs. 89-96).

The extent of terminalisation is also differential as at diakinesis many different conditions have been observed with respect to number and position of chiasmata. In the bivalent with two chiasmata, one of the chiasma may or may not be released. As a result in diakinesis, this bivalent appears either rod shaped or as a ring bivalent (Figs. 88).
Observations

This is seen even at metaphase I. $X_1X_2$ become more clearly distinct. Microchromosomes tend to come closer to each other (Figs. 100, 101).

At metaphase I, autosomal bivalents form a ring, $m$-pseudobivalent lies in the centre and closely associated but distinctly visible $X_1$ and $X_2$ lie outside the ring (Figs. 100, 101). Anaphase I is reductional for autosomes and microchromosomes but equational for sex chromosomes. So that seven autosomes, single microchromosome and $X_1X_2$ move towards each pole (Figs. 102, 103).

During telophase I, the autosomes arrange themselves in a compact ring at each pole with microchromosome lying within and $X_1X_2$ lying outside the ring (Fig. 104). At metaphase II, autosomes and microchromosome form a ring with closely associated $X_1X_2$ lying outside the ring (Fig. 105).

C-banding

The fused $X_1X_2$ body is positively heterochromatic at diffuse stage. It becomes lighter as diplotene proceeds and becomes isopyknotic with the autosomal bivalents. No localized C-band is observed in autosomal bivalents at diplotene (Figs. 106, 107).

Fluorescent banding

At diffuse stage, sex chromosomes, $X_1$ and $X_2$ are DAPI and CMA$_3$ bright. At diplotene, all the elements are uniformly stained and no DAPI and CMA$_3$ signals are observed (Figs. 108-111).

Ag-NOR banding

One big or two small nucleolar bodies are observed at interphase. No NORs are observed at diplotene (Figs. 112-114).
8. *Cletus borealis* Blote, 1935

*(Photograph-7)*

The spermatogonial metaphase of *Cletus borealis* comprises eighteen elements which include fourteen autosomes, two microchromosomes and two sex chromosomes, $X_1$ and $X_2$ (Fig. 115). Two pairs of autosomes are extremely large (6.28µm and 5.71µm) and five pairs are small sized ranging from 2.0µm to 1.42µm. Sex chromosomes, $X_1$ and $X_2$ are unequal in size (1.57µm and 1.28µm) while microchromosomes (0.57µm) are the smallest elements. The total diploid complement length is 46.51µm (Table).

### Table: Metrical analysis of chromosomes of *Cletus borealis*  

$(2n=18=14A+2m+X_1X_20)$

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome</th>
<th>Sex chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7</td>
<td>(m)</td>
<td>$X_1$ $X_2$</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>6.28 5.71 2.0 2.0 2.0 1.85 1.42</td>
<td>0.57 1.57 1.28</td>
<td></td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 46.51 µm

The diffuse stage reveals $X_1$ and $X_2$ to be fused and lying on the periphery of highly decondensed autosomes (Fig. 116). At early diplotene, two large autosomal bivalents show two terminal chiasmata forming ring bivalents and five small autosomal bivalents show single terminal or subterminal chiasma each. In the following diplotene plates, one of the extremely large bivalents shows two chiasmata while the other shows one chiasma. In some plates, both show single chiasma each. $X_1$ and $X_2$ lie fused. Microchromosomes lie far apart (Figs. 117-119).
At metaphase I, autosomal bivalents form a ring while m-pseudobivalent lies in the centre of the ring and closely associated X₁X₂ lie slightly outside the ring (Fig. 120).

Anaphase I is reductional for autosomes and microchromosomes while equational for sex chromosomes (Fig. 121). At metaphase II, all the elements including autosomes, microchromosomes and sex chromosomes are peripheral in arrangement (Fig. 122).

C-banding

The X₁X₂ body is positively heterochromatic at diffuse stage. At diplotene, X chromosome, microchromosomes and autosomal bivalents are completely C-negative (Figs. 123, 124).

Fluorescent banding

At diffuse stage, X₁X₂ body is DAPI bright and CMA₃ dull. At diplotene, all the autosomal bivalents, microchromosomes, X₁ and X₂ are uniformly stained and no DAPI and CMA₃ signals are observed (Figs. 125-128).

Ag-NOR banding

One large irregular nucleolar body is observed at interphase. No NORs are observed at metaphase I (Figs. 129, 130).

9. *Cletus pallescens* Walker, 1871

*(Photograph-8)*

The male diploid complement of *Cletus pallescens* is comprised of seven pairs of autosomes, a pair of microchromosomes and two sex chromosomes, X₁ and X₂ (2n=18=7AA+2m+X₁X₂0). As depicted in diplotene plates, two pairs of autosomes are extremely large in size while rest of the five pairs are small in size. X₁ is larger
than X₂. Microchromosomes are the smallest elements of the complement (Figs. 132, 133).

At the diffuse stage, X₁ and X₂ are closely placed and lie on the periphery of highly decondensed autosomes (Fig. 131). At diplotene, one or two autosomal bivalents form ring bivalents with two terminal chiasmata while rest of the autosomes show single terminal chiasma per bivalent (Figs. 132, 133). Microchromosomes lie far apart in early stages but as diplotene progresses, they tend to move closer to each other. By diakinesis, they form a pseudobivalent (Fig. 134).

At metaphase I, autosomal bivalents form a ring, m-pseudobivalent lies in the centre and closely associated X₁X₂ lie outside the ring (Fig. 135). During anaphase I, autosomes and microchromosome divide reductionally and sex chromosomes divide equationally (Fig. 136). At metaphase II, autosomes roughly form a ring, microchromosome lies within the ring and X₁X₂ lie outside the ring (Fig. 137). During anaphase II, closely associated X₁ and X₂ move as laggard and are added to one of the nuclei (Fig. 138).

**C-banding**

The sex chromosomes, X₁ and X₂, microchromosomes and autosomal bivalents are completely C-negative at diffuse stage as well as diplotene (Figs. 139, 140).

**Fluorescent banding**

At diffuse stage, X₁X₂ body is DAPI and CMA₃ dull. At diplotene, all the elements are uniformly stained and no DAPI and CMA₃ signals are observed (Figs. 141-144).
10. *Cletomorpha hastata* (Fabricius, 1787)

*(Photograph-9)*

As revealed by spermatogonial metaphase plate, the male diploid chromosome complement of *Cletomorpha hastata* is comprised of twenty two elements which include eighteen autosomes, two microchromosomes and two sex chromosomes, $X_1$ and $X_2$ (Fig. 145). Three autosomal pairs (4.14µm, 3.28µm and 2.71µm) are distinctly larger while the rest show gradual gradation in size ranging from 2.28µm to 1.71µm. $X_2$ (0.71µm) is smaller in size than $X_1$ (1.28µm). Microchromosomes (0.57µm) are the smallest elements of the complement. The largest chromosome appears curved and shows a lightly stained constricted region. The total diploid complement length is 47.63µm (Table).

**Table: Metrical analysis of chromosomes of *Cletomorpha hastata*  
*(2n=22=18A+2m+X_1X_2)*

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome</th>
<th>Sex chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>4.14</td>
<td>3.28</td>
<td>2.71</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 47.63µm

During the diffuse stage, $X_1$ and $X_2$ remain fused together to form a darkly stained heteropycnotic body lying on the periphery of partially decondensed autosomes (Fig. 146). At early diplotene, $X_1$ and $X_2$ remain fused. Autosomal bivalents show single chiasma per bivalent which can be terminal, sub-terminal or interstitial. The microchromosomes come close to each other to form a pseudobivalent and are lightly stained (Figs. 147, 148). As diplotene proceeds towards diakinesis, $X_1$
and X₂ become distinct but remain closely associated. In some diakinesis plates, microchromosomes are seen to lie far apart (Fig. 149).

At metaphase I, all the autosomal bivalents form a ring, m – pseudobivalent lies in the centre of the ring and closely associated X₁X₂ lie outside the ring (Fig. 150).

At metaphase II, a regular ring of chromosomes is not observed (Fig. 151). In most of the plates, one autosome lies far away from rest of the chromosomes. At early anaphase II, the autosomes can be seen dividing equationally while closely associated X₁X₂ moving towards one of the poles (Fig. 152).

**C-band**

Fused X₁X₂ body is C-positive during the diffuse stage as well as diplotene. Autosomal bivalents and microchromosomes are completely C-negative at diffuse stage as well as diplotene (Figs. 153, 154).

**Fluorescent banding**

At diffuse stage, fused X₁X₂ body is DAPI bright and CMA₃ dull. At diplotene, all the elements are uniformly stained with DAPI and CMA₃ (Figs. 155-158).

**Ag-NOR banding**

One nucleolar body is observed at interphase (Fig. 159).

**11. Cletomorpha raja Distant, 1901**

*(Photograph-10)*

The male diploid chromosome complement of *Cletomorpha raja* is comprised of eight pairs of autosomes, a pair of microchromosomes and two sex chromosomes, X₁ and X₂ (2n= 8AA+2m+X₁X₂0). As depicted in diplotene and metaphase I plates,
one pair of autosomes is extremely large as compared to rest of the seven pairs. Microchromosomes constitute the smallest elements of the complement. $X_2$ is smaller than $X_1$ (Figs. 162, 163).

At the diffuse stage, fused $X_1X_2$ form a darkly stained heteropycnotic body lying on the periphery of decondensed autosomes (Fig. 160). During diplotene, two types of plates are observed. In some plates, all autosomal bivalents show single terminal chiasma each whereas in others, the largest bivalent forms a ring bivalent with two terminal chiasmata. The microchromosomes come close to each other and are lightly stained. $X_1$ and $X_2$ lie closely associated (Figs. 161, 162).

At metaphase I, autosomal bivalents arrange themselves in a ring, m-pseudobivalent lies in the centre and closely associated $X_1$ and $X_2$ lie outside the ring (Fig. 163). Anaphase I is reductional for the autosomes and microchromosomes while equational for the sex chromosomes. Two equationally dividing sex chromosomes can be seen moving towards both poles during anaphase I (Fig. 164). Each pole receives eight autosomes, single microchromosome and $X_1X_2$ (Fig. 165).

At metaphase II, seven autosomes roughly form a ring with one autosome and microchromosome lying inside the ring and $X_1X_2$ lying outside the ring (Fig. 166).

**C-banding**

The sex chromosomes, $X_1$ and $X_2$, microchromosomes and autosomal bivalents are completely C-negative at diffuse stage as well as diplotene (Figs. 167, 168).

**Fluorescent banding**

At diffuse stage, fused $X_1$ and $X_2$ are both DAPI and CMA$_3$ dull. At diplotene, all the elements are uniformly stained and no DAPI and CMA$_3$ signals are observed. Microchromosomes are negative to both the stains (Figs. 169-172).
ii) Tribe: Homoeocerini

12. *Homoeocerus borealis* Distant, 1918  

*(Photograph-11)*

The male diploid chromosome complement of *Homoeocerus borealis* is comprised of nine pairs of autosomes, a pair of microchromosomes and a sex chromosome, X (2n=9AA+2m+X0). As depicted in diplotene and metaphase I plates, two pairs of autosomes are larger as compared to rest of seven pairs of autosomes which vary from medium to small size. X chromosome is equal in size to the small sized autosomes. Microchromosomes constitute the smallest elements of the complement (Figs. 174, 176).

At the diffuse stage, darkly stained X chromosome lies against decondensed autosomes (Fig. 173). During diplotene, all autosomal bivalents show single chiasma each which is terminal or sub-terminal (Fig. 174). As diplotene proceeds towards diakinesis, chromosomes condense further and X appears distinctly bipartite (Fig. 175).

At metaphase I, all the nine autosomal bivalents arrange themselves in a ring with m-pseudobivalent lying in the centre and X lying outside the ring (Fig. 176). Anaphase I is reductional for the autosomes and microchromosomes while equational for the sex chromosomes. Equationally dividing X chromosome can be seen moving towards the poles (Fig. 177).

At metaphase II, eight autosomes and microchromosome roughly form a ring with one autosome lying inside the ring and X lying outside the ring (Fig. 178).
During anaphase II, autosomes and microchromosomes divide equationally while X chromosome divides reductionally and is seen moving as a laggard towards one of the poles (Fig. 179).

**C-banding**

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes are negative for C-banding. Three autosomal bivalents show terminal and interstitial C-bands. Five small autosomal bivalents show terminal bands at both the ends. One autosome is weakly C-positive and shows thin C-bands (Figs. 180, 181).

**Fluorescent banding**

At diffuse stage, X chromosome is DAPI and CMA₃ bright. At diplotene, all C-positive regions are DAPI and CMA₃ bright (Figs. 182-185).

13. *Homoeocerus lacertorsus* Distant, 1889

*(Photograph-12)*

As revealed by spermatogonial metaphase plate, the male diploid chromosome complement of *Homoeocerus lacertorsus* comprises twenty one elements which include eighteen autosomes, a pair of microchromosomes and a sex chromosome, X (Fig. 186). Out of nine autosomal pairs, three are large (3.71µm to 3.28µm) while rest are medium to small sized varying in length from 2.85µm to 1.71µm. X chromosome (4.42µm) is the longest element of the complement while microchromosomes (1.14µm) are the shortest. The diploid total complement length is 54.62µm (Table).
Table: Metrical analysis of chromosomes of *Homoeocerus lacertorsus*

(2n= 21=18A+2m+X0)

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
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<tr>
<td>Length (µm)</td>
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<td>1.14</td>
<td>4.42</td>
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</table>

Total Diploid Complement Length (TCL) =54.62 µm

During the diffuse stage, darkly stained heteropycnotic X chromosome lies on the periphery of decondensed autosomes (Fig. 187). At diplotene, autosomal bivalents show single terminal, sub-terminal or interstitial chiasma each. X chromosome appears distinctly bipartite. Microchromosomes remain far apart from each other and remain so upto diakinesis (Figs. 188, 189).

At metaphase I, all the nine autosomal bivalents are arranged in a ring, microchromosomes come close to form a pseudobivalent that lies in the centre of the ring and X lies outside the ring (Fig. 190). During anaphase I, autosomes and microchromosomes divide equationally while X chromosome divides reductionally so that each pole receives nine autosomes, one microchromosome and X chromosome (Fig. 191). At metaphase II, autosomes and X chromosome roughly form a ring with microchromosome lying in the centre (Fig. 192). During anaphase II, autosomes and microchromosome divide equationally while X chromosome divides reductionally and adds to one of the poles as a laggard (Fig. 193). Two types of telophase II nuclei are thus formed, one with n=9A+m+X and the other with n=9A+m +0.

**C-banding**

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes are negative for C-banding. Six
autosomal bivalents show thick terminal C-bands while three show thin C-bands (Figs. 194, 195).

**Fluorescent banding**

At diffuse stage, X chromosome is DAPI bright and CMA$_3$ dull. All C-positive regions appear DAPI bright and CMA$_3$ dull (Figs. 196-199).

14. *Homoeocerus signatus* Walker, 1871

*(Photograph-13)*

As revealed by spermatogonial metaphase plate, the male diploid chromosome complement of *Homoeocerus signatus* comprises twenty one elements which include eighteen autosomes, a pair of microchromosomes and a sex chromosome, X (Fig. 200). One pair of autosomes is distinctly large (3.28µm) while eight pairs are of medium to small sized ranging from 2.57µm to 1.71µm. X chromosome (2.28µm) is equal to one of the medium sized autosomes. Microchromosomes are the smallest elements of the complement (0.85µm). The total diploid complement length is 44.18µm (Table).

<table>
<thead>
<tr>
<th>Table: Metrical analysis of chromosomes of <em>Homoeocerus signatus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(2n= 21=18A+2m+X0)</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Length (µm)</td>
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</tr>
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<td>8</td>
<td>0.85</td>
<td>2.28</td>
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</tbody>
</table>

Total Diploid Complement Length (TCL) =44.18µm
During the diffuse stage, darkly stained heteropycnotic X chromosome lies on the periphery of decondensed autosomes (Fig. 201). At diplotene, autosomal bivalents show single terminal, sub-terminal or interstitial chiasma each. X chromosome appears distinctly bipartite and microchromosomes remain far apart from each other and remain so upto diakinesis (Figs. 202, 203).

At metaphase I, all the nine autosomal bivalents are arranged in a ring, m-pseudobivalent lies in the centre of the ring and X lies outside the ring (Fig. 204). During anaphase I, autosomal bivalents and microchromosomes divide equationally while X-chromosome divides reductionally so that each pole receives nine autosomes, one microchromosome and X chromosome (Fig. 205). At metaphase II, autosomes and microchromosome form a compact ring while X lies outside the ring (Fig. 206). During anaphase II, autosomes and microchromosomes divide equationally while X chromosome divides reductionally and adds to one of the poles as a laggard (Fig. 207).

**C-banding**

The X chromosome is positively heterochromatic at diffuse stage and diplotene. All the autosomal bivalents show terminal C-bands at one or both the terminal ends at diplotene. Microchromosomes appear negative for C-banding (Figs. 208, 209).

**Fluorescent banding**

At diffuse stage, X chromosome is both DAPI and CMA3 bright. At diplotene, all C-bands are DAPI and CMA3 positive (Figs. 210-213).

**Ag-NOR banding**

One nucleolar body is observed at interphase (Fig. 214).
15. *Homoeocerus macula* Dallas, 1852

The male diploid chromosome complement of *Homoeocerus macula* is comprised of nine pairs of autosomes, a pair of microchromosomes and a sex chromosome, X. As depicted in diplotene plates, two autosomal pairs are comparatively larger than rest of the seven pairs which show gradual gradation in size. Microchromosomes constitute the smallest elements of the complement. These are comparatively larger than observed in other coreids. X is equal to the smallest autosomes (Fig. 216).

During the diffuse stage, darkly stained heteropycnotic X chromosome lies on the periphery of partially decondensed autosomes (Fig. 215). At diplotene, autosomal bivalents show single terminal or sub-terminal chiasma each. X chromosome appears distinctly bipartite at diplotene (Figs. 216, 217).

At metaphase I, autosomal bivalents form a ring, microchromosomes come close to form a pseudobivalent that lies in the centre of the ring and X lies outside the ring (Fig. 218). During anaphase I, autosomes and microchromosomes divide equationally while X-chromosome divides reductionally so that each pole receives nine autosomes, one microchromosome and X chromosome (Fig. 219). At metaphase II, autosomes, microchromosome and X chromosome are compactly arranged (Figs. 220).

During anaphase II, autosomes and microchromosomes divide equationally while X chromosome divides reductionally. X chromosome can be seen moving to one of the poles as a laggard. Two types of telophase II nuclei are formed, one with n=9A+m+X and the other with n=9A+m+0 (Fig. 221).
C-banding

The X chromosome is positively heterochromatic at diffuse stage. At diplotene, all autosomal bivalents show C-bands at one or both terminal ends. Microchromosomes and X chromosome also show C-positive regions (Figs. 222, 223).

Fluorescent banding

At diffuse stage, X chromosome is DAPI and CMA\textsubscript{3} bright. At diplotene, X chromosome is slightly DAPI bright and CMA\textsubscript{3} positive. Microchromosomes are both DAPI and CMA\textsubscript{3} dull with a slight bright region at one end. Autosomes show differential banding pattern. On autosomal bivalents 1 and 2, overlapping DAPI and CMA\textsubscript{3} positive signals are seen on chiasmatic as well as non-chiasmatic ends. Chromosome 3 is DAPI dull and CMA\textsubscript{3} bright. Autosomal bivalents 4, 5 and 6 show weak DAPI and CMA\textsubscript{3} signals. Autosomal bivalent 7 is throughout DAPI bright and CMA\textsubscript{3} dull with an overlapping bright DAPI and CMA\textsubscript{3} terminal signal. Autosomal bivalents 8 and 9 are homogeneously bright for DAPI and CMA\textsubscript{3} (Figs. 224-227).

iii) Tribe: Acanthocorini

16. *Acanthocoris anticus* Walker, 1871

(Photograph-14)

The spermatogonial metaphase of *A. anticus* reveals twenty four elements (Fig. 228). The complement is comprised of eleven pairs of autosomes and two sex chromosomes, X\textsubscript{1} and X\textsubscript{2}. Nine pairs of autosomes show gradation from large to medium size ranging from 3.14\textmu m to 2.42\textmu m while two pairs are distinctly smaller in size (1.85\textmu m and 1.42 \textmu m). X\textsubscript{1} (1.71\textmu m) is larger than X\textsubscript{2} (1.14 \textmu m). The male
diploid chromosome complement of *Acanthocoris anticus* is expressed as 2n = 24 = 22A + X₁X₂0. The total diploid complement length is 60.47µm (Table).

**Table: Metrical analysis of chromosomes of *Acanthocoris anticus***

\[(2n=24=22A+2m+X_1X_2)\]

<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Autosomes</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Length (µm)</td>
<td>3.14</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 60.47µm

Diffuse stage reveals darkly stained fused X₁ and X₂ lying against highly decondensed autosomes (Fig. 229). During diplotene, each autosomal bivalent shows single chiasma which may be terminal, sub-terminal or interstitial. X₁ and X₂ lie fused (Fig. 230). Bivalents condense further at diakinesis while X₁ and X₂ become distinct but remain closely associated (Fig. 231).

At metaphase I, two types of plates are observed. In one, all the autosomal bivalents form a ring and closely associated X₁ and X₂ lie outside the ring while in the other, one or two autosomal bivalents lie within the ring formed by rest of the bivalents and closely associated X₁ and X₂ lie outside the ring (Figs. 232-234). During anaphase I, autosomal bivalents divide reductionally while closely placed X₁ and X₂ divide equationally (Fig. 235).

At metaphase II, ten autosomes form a ring while one autosome lies in the centre. Closely associated X₁ and X₂ lie away from autosomes (Figs. 236, 237).
During anaphase II, autosomes divide equationally while sex chromosomes divide reductionally and lag behind the autosome (Fig. 238). Two types of nuclei are formed, one with 11A+X₁X₂ and the other with 11A+0.

17. *Acanthocoris* sp.

The male diploid chromosome complement of *Acanthocoris* sp. is comprised of eleven pairs of autosomes and two sex chromosomes, X₁ and X₂ (2n=24=11AA+X₁X₂0). As depicted in diplotene and metaphase I plates, out of eleven pairs of autosomes, two are distinctly smaller than rest of the nine pairs. X₁ and X₂ are equal in size to the smaller pair of autosomes (Figs. 240, 243).

During the diffuse stage, sex chromosomes, X₁ and X₂ appear fused to form a single darkly stained heteropycnotic body while autosomes are partially decondensed (Fig. 239). At diplotene, two to three of the autosomal bivalents are seen as ring bivalents with two chiasmata while the rest show single chiasma per bivalent which may be terminal or sub-terminal. Sex chromosomes, X₁ and X₂ appear fused throughout diplotene and diakinesis (Figs. 240-242).

At metaphase I, autosomal bivalents form a ring, X₁ and X₂ become distinct but remain closely associated and lie outside the ring (Fig. 243). During anaphase I, autosomal bivalents divide reductionally while sex chromosomes divide equationally so that each pole receives eleven autosomes and two sex chromosomes, X₁ and X₂ (Fig. 244). During metaphase II, autosomes form a ring and X₁X₂ lie outside the ring (Fig. 245). At telophase II, two sets of chromosomes are observed, one with 2n=11A + X₁X₂ and the other with 2n = 11A + 0 (Fig. 246).
Fluorescent banding

In autosomal bivalents, terminal and interstitial bands are seen which appear bright with DAPI as well as CMA$_3$. Sex chromosomes, X$_1$ and X$_2$, too, are bright with DAPI and CMA$_3$ (Figs. 247-250).

18. *Petalocnemis obscura* (Dallas, 1852)

(Photograph:15)

As revealed by spermatogonial metaphase plate, the diploid chromosome complement of *Petalocnemis obscura* is 2n=26 (Fig. 251). The complement comprises eleven pairs of autosomes, a pair of microchromosomes and two sex chromosomes, X$_1$ and X$_2$. The autosomal pairs can be arranged into three groups based on size differences: five pairs large (3.42µm to 3.14µm), four pairs medium (2.85µm to 2.28µm) and two pairs small (1.28µm and 1.14µm). X$_1$ and X$_2$ are unequal in size, X$_2$ (1.28 µm) being smaller than X$_1$ (1.57µm). Microchromosomes (0.71µm) are the smallest elements of the complement. The total diploid complement length is 59.63µm (Table).

**Table: Metrical analysis of chromosomes of *Petalocnemis obscura***

(2n= 26=22A+2m+X$_1$X$_2$0)

<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (µm)</td>
<td>3.42 3.42 3.42 3.28 3.14 2.85 2.42 2.28 2.28 1.28 1.14 0.71</td>
<td>1.57 1.28</td>
<td></td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 59.63µm
At the diffuse stage, darkly stained single heteropycnotic body representing fused X_1 and X_2 lies against highly decondensed autosomes (Fig. 252). At diplotene, each autosomal bivalent shows single chiasma which can be terminal or sub-terminal. The microchromosomes are lightly stained and lie far apart from each other. X_1 and X_2 lie fused (Fig. 253). As meiosis proceeds towards diakinesis, the autosomes condense further. Closely associated X_1 and X_2 can now be distinctly seen, X_1 being slightly bigger than X_2 (Fig. 254).

At metaphase I, autosomal bivalents arrange to form a ring, m-pseudobivalent places itself in the centre and X_1X_2 lie outside the ring (Fig. 255). Anaphase I is reductional for autosomes and microchromosomes but equational for sex chromosomes (Fig. 256).

At metaphase II, autosomes arrange roughly in a ring with one or two autosomes and microchromosome lying inside the ring and X_1X_2 lying outside (Fig. 257). Anaphase II is reductional for sex chromosomes and equational for autosomes and microchromosome. Two types of nuclei are formed: one with 11A+m+X_1X_2 and the other with 11A+m+0 (Fig. 258).

**C-band**

At diffuse stage, fused X_1 and X_2 appear C-positive. At diplotene, nine autosomal bivalents show terminal C-bands on one or both the ends. Two autosomal bivalents and microchromosomes are completely C-negative. Closely associated X_1 and X_2 are darkly stained for C-band (Figs. 259, 260).

**Ag-NOR banding**

One big or two comparatively smaller nucleolar bodies are observed at interphase (Figs. 261, 262).
iv) Tribe: Anhomoeini

19. *Anhomoeus nepalensis* (Distant, 1908)

*(Photograph-19)*

Spermatogonial metaphase of *Anhomoeus nepalensis* reveals twenty one elements which include eighteen autosomes, two microchromosomes and one sex chromosome *i.e.*, X (Fig. 263). Autosomes show gradual gradation in size ranging from 2.57µm to 1.57µm. X chromosome (2.85µm) is the longest element of the complement while microchromosomes (0.28µm) are the smallest. The total diploid complement length is 39.63µm (Table).

**Table: Metrical analysis of chromosomes of *Anhomoeus nepalensis*  
(*2n*= 21=18A+2m+X0)**

<table>
<thead>
<tr>
<th>Chromosomes</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
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</thead>
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<td>2.85</td>
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<tr>
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<td></td>
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</table>

Total Diploid Complement Length (TCL) = 39.63µm

At diffuse stage, X chromosome forms a darkly stained heteropycnotic body lying against highly decondensed autosomes (Fig. 264). During diplotene, nine autosomal bivalents, two microchromosomes and X chromosome are observed. The autosomal bivalents show single chiasma each which may be terminal, sub-terminal or interstitial. Microchromosomes lie far apart from each other (Fig. 265). As
diplotene proceeds towards diakinesis, chromosomes condense further and X appears distinctly bipartite (Fig. 266).

At metaphase I, all the nine autosomal bivalents form a ring, terminally associated m-pseudobivalent lies in the centre and X lies outside the ring (Fig. 267). During anaphase I, autosomes and microchromosomes divide reductionally and X chromosome divides equationally. Each pole receives nine autosomes, one microchromosome and one X chromosome (Fig. 268). During metaphase II, X chromosome lies away from the autosomal group (Fig. 269). During anaphase II, autosomes and microchromosome divide equationally while X chromosome divides reductionally. X-chromosome is seen moving towards one of the poles as a laggard. Two types of nuclei are formed at telophase II, one with n=9A+m+X and the other with n= 9A+m+0 (Fig. 270).

C-banding

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes are negative for C-banding. All autosomal bivalents show terminal/subterminal C-bands (Figs. 271, 272).

Fluorescent banding

At diffuse stage, X chromosome is DAPI and CMA$_3$ bright. At diplotene, all C banded regions are both DAPI and CMA$_3$ bright (Figs. 273-276).

Ag-NOR banding

At diplotene, four autosomal bivalents appear negative while five appear positive for silver staining (Fig. 277).
20. *Anhomoeus sulcatus* (Distant, 1908)

*(Photograph-17)*

The male diploid chromosome complement of *Anhomoeus sulcatus* is comprised of nine pairs of autosomes, a pair of microchromosomes and a sex chromosome, X (2n=9AA+2m+X0). As depicted in diplotene plates, one autosomal pair is distinctly large as compared to rest of the eight pairs. Microchromosomes constitute the smallest element of the complement (Figs. 279, 280).

During the diffuse stage, darkly stained rod-shaped heteropycnotic X chromosome lies at the periphery of highly decondensed autosomes (Fig. 278). At diplotene, autosomal bivalents show single terminal or sub-terminal chiasma each (Figs. 279, 280). By diakinesis, chromosomes condense further and microchromosomes come near to each other (Fig. 281).

At metaphase I, autosomal bivalents form a ring, m-pseudobivalent comes to lie in the centre of the ring and X lies outside the ring (Fig. 282).

During anaphase II, autosomes and microchromosome divide equationally while X chromosome divides reductionally and can be seen moving towards one of the poles as a laggard (Fig. 283).

**C-banding**

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes are negative for C-banding. All autosomal bivalents show thick terminal C-bands (Figs. 284, 285).

**Fluorescent banding**

At diplotene, X chromosome is DAPI and CMA₃ bright. All C-bands are DAPI and CMA₃ bright (Figs. 286, 287).
v) Tribe: Cloresmini

21. *Notobitus affinis* (Dallas, 1852)

(Photograph-18)

As revealed by spermatogonial metaphase plate, the male diploid chromosome complement of *Notobitus affinis* comprises twenty one elements which include eighteen autosomes, a pair of microchromosomes and a sex chromosome, X (Fig. 288). Autosomes can be assigned two groups based on size differences. First group includes five autosomal pairs ranging from 2.85µm to 2.14µm and the second group includes four autosomal pairs ranging from 1.85µm to 1.57µm. X chromosome (3.28µm) is the largest element of the complement and microchromosomes (0.85µm) are the shortest element of the complement. The total diploid complement length is 43.48µm.

<table>
<thead>
<tr>
<th>Chromosomes</th>
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<th>Microchromosome (m)</th>
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<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (µm)</td>
<td>2.85 2.71 2.57 2.28 2.14 1.85 1.71 1.57 1.57</td>
<td>0.85</td>
<td>3.28</td>
</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 43.48µm

At the diffuse stage, darkly stained heteropycnotic X chromosome lies on the periphery of partially decondensed autosomes (Fig. 289). At diplotene, two to three autosomal bivalents show two terminal chiasmata forming ring bivalent while rest show single terminal, sub-terminal or interstitial chiasma each. X chromosome
appears highly condensed and is darkly stained. Microchromosomes are placed apart from each other and remain so up to diakinesis (Figs. 290-292).

At metaphase I, autosomal bivalents form a ring, m-pseudobivalent lies in the centre and X lies outside the ring (Fig. 293). First meiotic division is reductional for autosomes and microchromosomes while equational for sex chromosome. Hence, each pole receives nine autosomes, one microchromosome and X chromosome (Fig. 294). At metaphase II, nine autosomes and microchromosome form a compact ring while X lies outside the ring (Fig. 295).

**C-banding**

At diplotene, microchromosomes and X are positive for C-banding. All autosomal bivalents show heavy terminal and weak interstitial C-bands (Figs. 296, 297).

**Fluorescent banding**

At diffuse stage, X chromosome is DAPI and CMA$_3$ bright. At diplotene, all C-banded regions are DAPI and CMA$_3$ bright (Figs. 298-301).

**vi) Petascelini**

**22. *Petillopsis patulicollis* (Walker, 1871)**

*(Photograph-19)*

Spermatogonial metaphase of *Petillopsis patulicollis* reveals twenty eight elements which include twenty four autosomes, two microchromosomes and two sex chromosomes, $X_1$ and $X_2$ (Fig. 302). Three autosomal pairs (1.42µm and 1.28µm) are distinctly smaller as compared to rest of the nine pairs which show slight gradation of size ranging from 2.85µm to 1.71µm. $X_1$ (1.14µm) and $X_2$ (1.00µm) are slightly
unequal in size. Microchromosomes (0.85) are the smallest elements of the complement. The total diploid complement length is 50.88µm.

**Table: Metrical analysis of chromosomes of *Petillopsis patulicollis***

(2n= 28=24A+2m+X₁X₂0)

<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Autosomes</th>
<th>Microchromosome (m)</th>
<th>Sex chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (µm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.85</td>
<td>0.85</td>
<td>X₁</td>
</tr>
<tr>
<td>2</td>
<td>2.71</td>
<td></td>
<td>X₂</td>
</tr>
<tr>
<td>3</td>
<td>2.14</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>2.14</td>
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<tr>
<td>5</td>
<td>2.00</td>
<td>2.00</td>
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<tr>
<td>6</td>
<td>2.00</td>
<td>2.00</td>
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</tr>
<tr>
<td>7</td>
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<td>1.71</td>
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<tr>
<td>8</td>
<td>1.42</td>
<td>1.42</td>
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</tr>
<tr>
<td>9</td>
<td>1.42</td>
<td>1.28</td>
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<td>11</td>
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<td></td>
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<tr>
<td>12</td>
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</tr>
</tbody>
</table>

Total Diploid Complement Length (TCL) = 50.88µm

Diffuse stage reveals darkly stained fused X₁ and X₂ lying on the periphery of decondensed autosomes (Fig. 303). During diplotene, one bivalent shows two chiasmata while rest show single chiasma per bivalent which may be terminal, sub-terminal or interstitial. Microchromosomes lie far apart and X₁ and X₂ still appear fused (Fig. 304). By diakinesis, microchromosomes come close and two unequal sex chromosomes become distinct (Fig. 305).

At metaphase I, two types of plates are observed. In one, all the autosomal bivalents form a ring and X₁X₂ lie outside the ring (90%) while in the other, one or two autosomal bivalents lie within the ring formed by rest of the bivalents and X₁X₂ lie outside the ring (10%). Micro-pseudobivalent lies within the ring formed by autosomes (Figs. 306, 307). During anaphase I, microchromosome and autosomal bivalents divide reductionally while X₁ and X₂ divide equationally so that each pole receives twelve autosomes, one microchromosome and two sex chromosomes, X₁ and X₂ (Fig. 308).

At metaphase II, eleven autosomes and microchromosome form a ring while one autosome lies within the ring and fused X₁X₂ lie outside the ring (Fig. 309).
Observations

C banding

At diffuse stage as well as diplotene, X chromosome is positively heterochromatic. Autosomal bivalents show terminal and interstitial C-bands (Figs. 310, 311).

Fluorescent banding

At diffuse stage, sex chromosomes, X₁ and X₂ are DAPI bright and CMA₃ dull. At diplotene, the largest autosomal bivalent which is otherwise DAPI bright and CMA₃ dull throughout, shows bright terminal CMA₃ localized regions which are DAPI dull. Five autosomal bivalents are homogeneously bright to DAPI and dull to CMA₃. Five show positive signals for both the stains at chiasmatic ends. One small autosomal bivalent is negative for both the stains. X₁ shows three overlapping DAPI and CMA₃ regions while X₂ is completely positive for both the stains (Figs. 312-315).

Ag-NOR banding

One nucleolar body is observed at interphase (Fig. 316).

SUBFAMILY:PSEUDOPHLOEINAE

(i) Tribe: Clavigrallini

1. *Clavigralla scutellaris* (Westwood, 1842)

(Photograph-20)

The male diploid chromosome complement of *Clavigralla scutellaris* is comprised of five pairs of autosomes, a pair of microchromosomes and a sex chromosome, X (2n=10AA+2m+X0). As depicted in diplotene and metaphase I plates, autosomes show slight gradation in size. Microchromosomes comprise the smallest element of the complement. X is smaller than the autosomes (Figs. 318, 320).
Observations

Diffuse stage reveals darkly stained X-chromosome lying against highly decondensed autosomes (Fig. 317). During diplotene, all the autosomal bivalents show single chiasma each which may be terminal, sub-terminal or interstitial. X appears distinctly bipartite. Microchromosomes lie close to each other and are faintly stained (mostly untraceable) (Fig. 318). By diakinesis, autosomal bivalents and X condense further (Fig. 319).

Autosomal bivalents form a ring during metaphase I with m-pseudobivalent (just a speck) lying within and X chromosome lying outside the ring (Fig. 320). During metaphase II, X chromosome lies far away from the autosomal group and is seen moving towards one of the poles as a laggard during anaphase II (Figs. 321, 322).

C-banding

The X chromosome is positively heterochromatic at diffuse stage and diplotene. At diplotene, microchromosomes are negative for C-banding and are mostly untraceable. All autosomal bivalents show thick blocks of terminal/subterminal C-bands (Figs. 323, 324).

Fluorescent banding

At diffuse stage, X chromosome is DAPI and CMA₃ bright. At diplotene, All C-positive regions are DAPI and CMA₃ bright (Figs. 325-328).