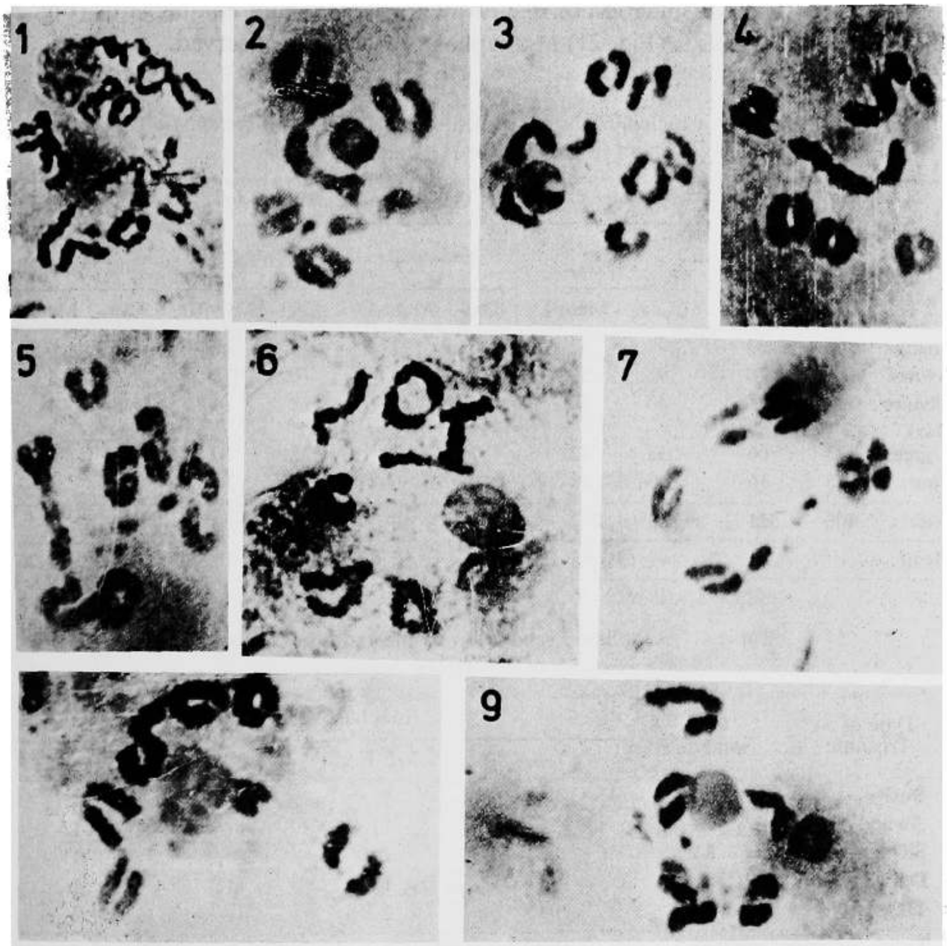
and metaphase I (Fig. 12) was 32.5 per cent and 36.3 per cent, respectively. Other types of chromosome associations at diakinesis such as $6^{II}+3^{I}$ and $5^{II}+1^{III}+2^{I}$ were observed in 0.8 per cent of the cells.

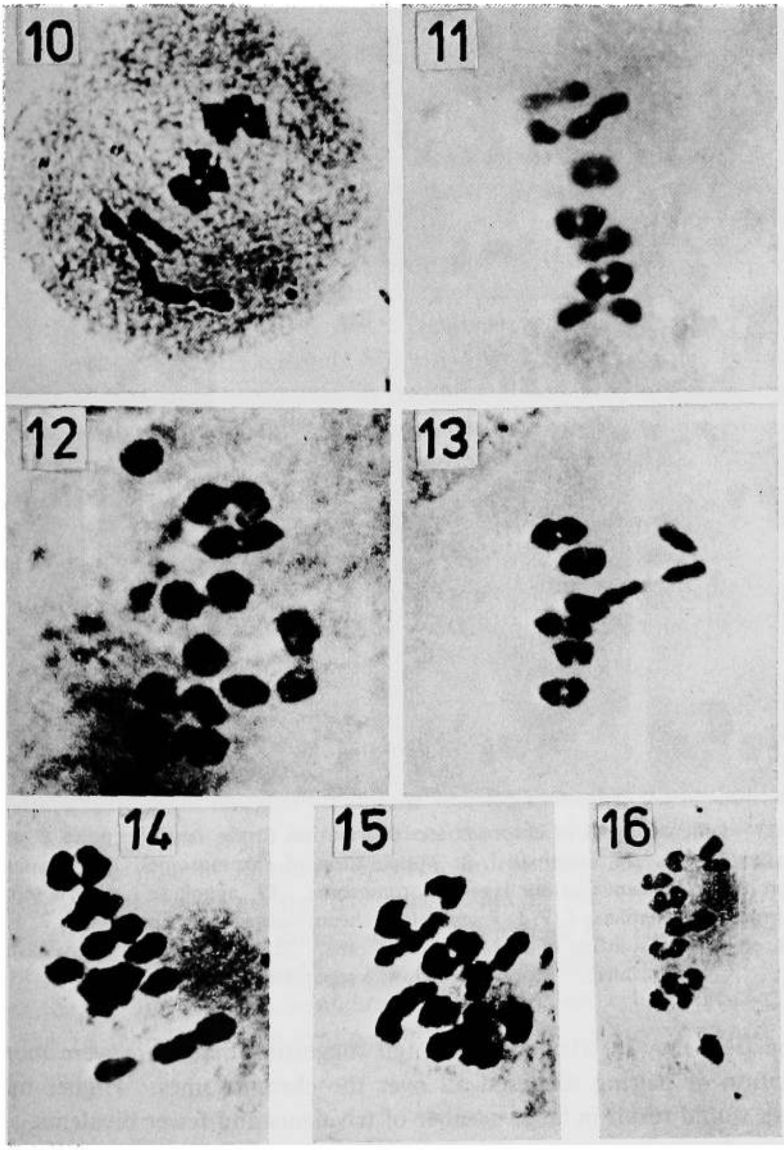
The three homologous chromosomes of a trisomic showed V-, inverted S, L-, Y-, frying pan, S- and J-shape configurations. The chain of three (Fig. 14) was the most frequent configuration, being 65 per cent at diakinesis and 63 per cent at metaphase I followed by frying pan (Fig. 7, approx. 19 per cent both at diakinesis and metaphase I). Other types of configurations (Figs. 2 to 9) at diakinesis were observed in about 8 per cent of the cells. At metaphase I frequency of V-shape (Fig. 16) trivalents increased (12 per cent), whereas, other types of configurations decreased (6 per cent). Chromosome length influenced the frequency of different



Figs. 1–9. Different trivalent types at diakinesis. Magnification. ×500. 1, diplotene, $5^{II}+1^{V}$. 2, diakinesis, $6^{II}+1^{III}$, V-shaped. 3, diakinesis, $6^{II}+1^{III}$, inverted S-shaped. 4, diakinesis, $6^{II}+1^{III}$, L-shaped. 5, diakinesis, $6^{II}+1^{III}$, Y-shaped. 6, diakinesis, $6^{II}+1^{III}$, 4-shaped. 7, diakinesis, $6^{II}+1^{III}$, Frying pan-shaped. 8, diakinesis, $6^{II}+1^{III}$, S-shaped. 9, diakinesis, $6^{II}+1^{III}$, J-shaped.

Discussion

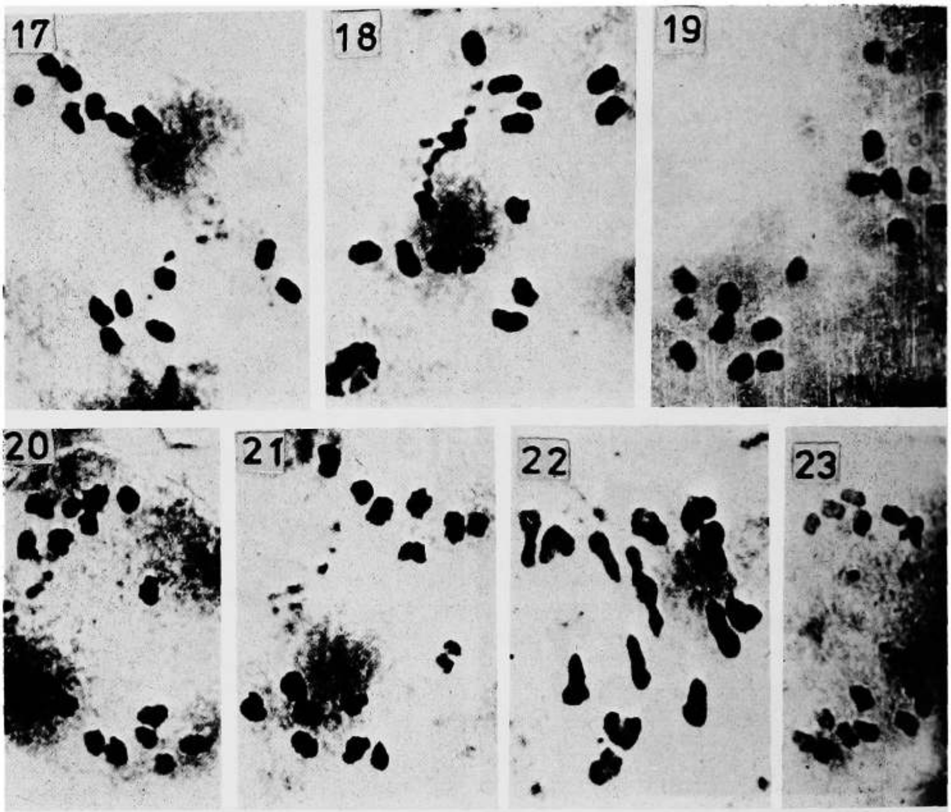
In the present investigation trisomics were produced from three different sources i.e., desynaptic plant, triploid and translocation heterozygote. The desynaptic plant showed univalents ranging from 0 to 13 at diakinesis and metaphase I. In triploid plant 36% of the cells showed eight chromosome separation to one pole at anaphase I. Of the three sources as reported in this case, trisomics were most



Figs. 10–16. Different chromosome associations and types of trivalents at metaphaes I. Magnification. ×500. 10, $5^{II}+1^{V}$, chain of five. 11, $6^{II}+1^{III}$, chain type. 12, $7^{II}+1^{I}$. 13, $6^{II}+1^{III}$, L-shaped. 14, $6^{II}+1^{III}$, rod shaped, early disjunction of one bivalent. 15, $6^{II}+1^{III}$, early disjunction of trivalent. 16, $6^{II}+1^{III}$, V-shaped.

frequent in the progeny of triploids.

The chromosome associations at diakinesis and metaphase I were usually $6^{II}+1^{III}$ or $7^{II}+1^{I}$, whereas $6^{II}+3^{I}$ were low in frequency. The trivalents exhibited different configurations, *viz.*, chain, frying pan, Y-, J-, S- and 4-shaped. There was no characteristic meiotic configuration of the specific trisomics. In trisomics three homologues of one chromosome are available for paring. If pairing initiates at a single point only a bivalent and a univalent will be formed. In the present study the frequency of trivalents was high suggesting that there were more points for initiation of pairing scattered all over the chromosomes. Higher number of chiasmata would result in large number of trivalents and fewer bivalents.



Figs. 17–23. Different types of chromosomes distribution to the opposite poles at anaphase I. Magnification, ×500. 17, anaphase I, 8: 7 separation of chromosomes. 18, anaphase I, late disjunction of one bivalent and one lagging chromosome. 19, anaphase I, 8: 1: 6 separation of chromosomes. 20, anaphase I, 7: 1: 7 separation chromosomes. 21, anaphase I, 7: 1: 7 separation of chromosomes, splitting of laggard chromosome. 22, mid anaphase I, late disjunction of one bivalent. 23, anaphase I, 9: 6 separation of chromosomes.

When chiasmata occur in all available segments the metaphase configuration reflects the pairing relations. The bivalent is usually a ring plus one univalent and the trivalent is a frying pan (Fig. 7). If interstitial chiasmata are few the trivalent will appear as chain (Fig. 14). but an occasional interstitial chiasma alongwith a distal