INTRODUCTION

Inuleae is one of the 13 tribes generally recognised in the family Compositae (Benthem & Hooker 1873, Clarke 1876, Bendele 1959). In Hooker's (1832) Flora of British India 11 of these tribes are represented. Inuleae has been further divided into 5 subtribes, namely Plucheineae, Filaginese, Gaaphalieae, Angiantheae and Euinuleae. The genera of the present study, namely Blumea DC and Lagogera Sch-Bip are among the 18 genera of the subtribe Plucheineae. Blumea and Lagogera are predominantly Asiatic in distribution. Both are well represented in India and of the two, Blumea has a better representation. Hooker views Blumea as eminently characteristic of India as compared to other genera of Compositae.

Blumea and Lagogera chiefly consist of annual herbs and share many common characters, namely heads heterogamous, usually with multiseriate marginal female florets, involucral bracts generally dry and scarious, receptacle palesaceous. Corollae of the female flowers tubular, filiform (rarely bilabiate), bisexual florets few, tubular. Anthers tailed at the base (or sagittate as in Lagogera). Lagogera is differentiated from Blumea by the sagittate anther bases and decurrent leaves. It is therefore felt that the combined study of Blumea and Lagogera be undertaken to understand the relationship, taxonomy and evolution in these taxa.
De Candolle had in fact included *Laggera Sch-Bip.* in *Blumea D.C.*, the latter named after the celebrated Dutch Botanist Blume. It was in 1845 that Schultz-Bipontinus made a change and erected a new genus *Laggera Sch-Bip.* having decurrent leaves and non-tailed (sagittate bases) anthers. *Laggera* consists of about 10 species and is distributed in Asia and Africa of which 4 are recorded for India. The species do not seem to have attained weedy proportion unlike *Blumea.* The constituent species are rather well differentiated from each other.

The genus *Blumea* is distributed in the tropical and subtropical regions of the old world being prominent among the weed flora of Africa, Madagascar, South East Asia through New Guinea and Australia. Several species of *Blumea* like *B. eliantha, B. oxydonta, B. obliqua, B. mollis* etc. have become veritable weeds in India invading the gardens and fields of dry crops. They are often found growing with species of *Brigeron, Sonysa, Cyathocline* etc. Some of the varieties and races are extremely hardy and can adapt themselves to varied ecological situations including those due to the activity of man such as industrial sites, slums, garbage dumps, road sides etc.

A.P. De Candolle in his "prodromus" recognized 76 species. Clarke (1876) wrote a treatise on the Indian Compositae and considered 26 species of *Blumea.* At a later period Hooker (1882) undertook a detailed floristic work on the British India.
(then including Pakistan, Ceylon and Burma) which culminated in the 'Flora of British India' (1876 to 1897). He recognised 36 species occurring in India. Cooke (1904) surveying for the Flora of the Bombay Presidency described 13 species. A much later work by Gamble (1921) on the Flora of the Presidency of Madras which covered a major portion of South India included 19 species of Blumea. Excepting a few local floras no further systematic work was undertaken in India. Panderia (1960) in her monograph on Blumea comprising of 49 species records 25 species as occurring in India of which 17 species were recorded from South India.

Many workers have opined from time to time that the genus Blumea presented many difficulties in delimiting the species and other categories due to highly variable nature of the species depending upon the geographic region, habitat and climate (Hooker 1882, Koster 1941, Pandiera 1960). Hooker(1882 Vol. III p. 260) remarks "there is no more unsatisfactory genus than this; it is distinguished from Laggera only by the tailed anther cells and this is not a constant character ..... The division of the genus proposed here are most unsatisfactory, and I fear that the specific diagnosis are not much better. The glabrous or pubescent receptacle is very difficult to see; the size of the head is tolerably constant; the forms and number of the involucral bracts are difficult to describe; the very minute
achenes are tolerably uniform; the foliage is sportive to an extra ordinary degree, as is the pubescence; gland hairs are common to most species, but the amount varies with the dryness of the locality. I have not been able to follow Clarke’s disposition of the species at all closely; they want a careful study in situ and under cultivation”. *Sanderia (loc. cit)* realizing the difficulty experienced by the previous workers remarks that a cytogenetic and possibly a chemotaxonomical investigation of the species would aid considerably in the delimitation of the taxonomic units and in visualizing the mode of evolution in the genus. She also suspected the presence of apomixis in a few species as she failed to observe pollen containing anthers in them.

In her monographic study of *Blumea*, *Sanderia (1960)* examined nearly 8000 herbarium specimens from all over the world in order to make a reassessment of the species. Though the work is on the lines of classical taxonomists, she made use of other characters of the plants such as epidermal cell, shapes of leaves, position of stomata on the leaves, nature of trichomes etc. in classification. Detailed morphological descriptions for each species and distribution maps are provided. She included 7 sections mostly based on De Candolle (1836) and Hooker (1882) though the species were somewhat rearranged in the light of careful
studies. Two new sections that were named by her were Sec. Sagittatae and Sec. Hieraciifolii. In the former she included the only species *E. sagittata* (based on the sagittata nature of leaves); in the latter were placed species closely resembling but formerly placed in different sections (Cf. Hooker, 1882). Similarly in the Sec. Paniculatae (including Senecioniflorae DC. and Fasciculiflorae DC.) she placed species like *E. mollis*, *E. lacera*, *E. virens*, *E. membranacea* etc. based on the characters of stomata on both surfaces, alveolate receptacle and generally paniculate inflorescence. These species apparently closely related were treated under different sections by De Candolle, Clarke and Hooker (loc. cit.). She reduced the numerous species of De Candolle to synonyms of a much lesser number of species. Similarly she merged several species of Hooker into new units. She has clarified to a greater extent the nomenclatural jargon in difficult genus like *Blumea*. As she confessed (p. 201) she was unable to arrive at any phylogenetic scheme showing the interrelationship of the constituent species though she strongly suspected hybridization and apomixis operating in the genus.

Most of the genera in the tribe Inuleae are not worked out cytologically in an extensive manner although considerable work is known in genera like *Pluchea*, *Vicoa*, *Pulicaria*, *Inula*, *Gnaphalium*, *Laggera* and *Antennaria*.

Somatic numbers in *Inula* species varies from 16 to 20
(Singh 1951; Tongiorgi 1942). Mehra et al. (1965) studied diploid and tetraploid forms of *Inula capra* (n=10 & 20) and meiosis was found to be normal. Baldwin and Speese (1955) did karyotypic and meiotic studies of 3 species of *Pluchea* namely *foetida*, *camphorata* and *purpurascens*. All the 3 species have n=10 chromosomes and meiosis in them was found to be regular. Cooperrider and Galang (1965) studied *Pluchea* of Hawaiian islands. *Pluchea indica* and *Rodorata* have n=10 chromosomes and meiosis was found to be regular. They have discovered a hybrid (n=10) between the above two species growing in the same island. The hybrid occupies a different ecological habitat and meiosis in PMCs was irregular. Singh (1951) recorded the gametic number of 10 for *Pulicaria crispa*, while Mehra et al. (loc.cit) determined n=9 chromosomes in the above species. Normal meiosis was found in *P. vulgaris* by Kulff (1937). Somatic number of 28 chromosomes has been determined by Sharma and Basudeo Varma (1960) in *Gnaphalium indiium*, while 56 chromosomes is recorded for *G. norvegicum* (Love and Love 1944). *G. glutinos-album* (Mehra et al. 1965) has the lowest basic number of n=7. This shows the existence of a polyploid series in *Gnaphalium*. This is further supported by other records in these and other species of *Gnaphalium* appearing in literature (Love and Love 1956; Turner et al. 1962 etc.). Mehra et al. (loc.cit) did meiotic studies in the following genera and species.

*Blumea lacera*, n=11.

*Vicoa vestita*, n=9.

*P. membranacea*, n=11.

*V. indica*, n=9.
In their earlier paper, Mehra and Sidhu (1960) reported the genetic number of 9 in Blumea wightiana. Chuang et al. (1963) determined n=10 chromosomes in Blumea balsamifera. Subramanyan & Nanil (1966) determined the number of n=9 in Blumea lacera. Banerji (1942) studied the embryology of B. laciniata. Love and Salbrig (1964) reported the somatic numbers for two genera in the tribe Inuleae. They are:

Anaphalis margaritacea, 2n=28. Antennaria aprica & A. parviflora, 2n=34. A. rosea, 2n=56. A. pulcherrima, 2n=63.

Darlington and Wylie (1955) report the somatic numbers for 4 other species of Antennaria (A. dioica, 28 & 34; A. neoglaoa, 28; A. solitaris, 28; A. fallax, 34). Karyomorphological studies in the subtribe Gnaphalineae including some species of Anaphalis and Gnaphalium have been done by Arano (1963).

**Antennaria** is probably the only genus in Inuleae subjected to extensive investigations. It forms an agamic complex with 12 to 15 different sexual species. The sexuals are generally apomictic - facultative and obligate. **Antennaria alpina** (2n=34. Love and Love 1966) and some species are worked out regarding the nature of apomixis (Juel, 1900; Stebbins, 1932; Bergman 1941). **A. alpina** infact is one of the first plants in the Phanerogams wherein the mechanism of apomixis was traced.
Battaglia (1963) has classified them under gonial apospory. Here, meiosis is circumvented in the spore mother cell and substituted by a long resting stage. Later, it divides mitotically to produce an 8-nucleate, functional embryo sac. The diploid egg gives rise to the embryo directly. Some nonfunctional embryo sacs may also be produced through a highly irregular meiosis resulting in tetrads of 4 to 7 cells. Antennaria carpatica (2n=40-42 Bergman, 1955; 2n=42, 56. Urbanska, 1959) has been worked out cyto-embryologically by Bergman (1951). Meiosis is irregular in ESC's and EGC's. In macrosporogenesis restitution nuclei are formed remarkably often. 3 types of 8 nucleate embryo sacs are formed - (a) more or less reduced, (b) unreduced through restitution nuclei (diplospory of Gustafsson 1946-47 or aneupory of Battaglia 1963 and (c) unreduced through somatic apospory. As already stated, above, embryo sacs through restitution nuclei are formed often and Battaglia (1963) has termed it as aneupory - Taraxacum type. But as observed by Bergman (1951) the unreduced embryo sacs lack capacity of parthenogenesis.

Thus it is seen that practically no cytological work has been done in Blumea and Lagenera which are so widely distributed in the old world. Literature on the cytological work of the family Compositae reveals that many of the genera tackled cytologically predominantly occur in the temperate regions.
The modern taxonomist who resorts to experimentation derives data from cytology, genetics and ecology in addition to the morphological characters and geographic distribution. Based on the accumulated information he seeks to explain variation, speciation and evolution. Methods of study by modern taxonomist are variously known as experimental taxonomy (Clements & Hall 1920), biosystematy (Camp & Gilly 1943), genealogy (Tarrasson 1923) and synthetic taxonomy (Turrill 1954). Cytotaxonomy has emerged as a discipline seeking to study variation and evolution in terms of cytology and morphology. As Darlington (1950) says "the chromosomes are not another character comparable with superficial characters of organisms ...... Changes in the chromosomes determine isolation and divergent evolution of races, ecotypes, species and family". The study of chromosomes, their morphology and behaviour is an useful tool of the cytotaxonomist since the chromosomes are the seats of hereditary characters often reflected in morphological features. The monographic work of Crepis by Babcock (1947) has more than amply demonstrated the role of chromosome studies in experimental taxonomy.

In the present investigation about 300 collections of
15 species belonging to 2 genera of tribe Inuleae have been collected from South-Western India and have been subjected to study as a part of the programme of work in Inuleae. Following are some of the problems which prompted the undertaking of present study.

1) Species like *Blumea oxyodonta*, *B. eriantha* and *B. membranacea* exhibit a great range of morphological diversity.

2) *B. oxyodonta*, *B. eriantha* and *B. malcolmii* are associated with polyploidy and show apomictic behaviour.

3) *B. lacera* and *B. hieraciifolia* being polyploids are nevertheless seem to be normal sexual species.

4) *B. virens* shows very close resemblance to *B. membranacea* and possess difficulties regarding its systematic position.

5) A few species seem to have ecological races.

6) Strong tendency of environmental variability in *B. oxyodonta*.

7) Several evolutionary trends in the genus *Blumea*.

For the present study 13 species of *Blumea* and 2 species of *Lawsera* have been collected from different parts of Western-South India. Idiograms and histograms have been made to assess the cytological relationships. This is supplemented by the meiotic studies of the collections in order to know the chromosome behaviour which might be useful in understanding the nature of speciation. Some interspecific and infraspecific hybridizations were performed to elucidate the relationships
among different taxa. Morphological characters were critically examined and correlated with cytological observations. Detailed studies have been done to trace the mechanism of apomixis in agamic forms.

It is hoped that the present study would provide a clearer picture of the evolutionary processes operating in the speciation of *Blumea* and *Leggrea* of Inuleae and help in a proper taxonomic treatment of the taxa involved.