INTRODUCTION

Among the various disciplines of Biological Science, Soil Zoology has made a steady and satisfactory progress in the last few decades. With the development of standard techniques of sampling, extraction and culture of soil animals, workers from different corners of the globe have now engaged themselves to unfold the mysteries concerning soil fauna and their interactions with various edaphic factors.

Soil as an ecosystem supports a wide variety of soil animals, which in their turn exert a profound influence in maintaining soil structure and in increasing soil fertility. Of the various components of soil fauna, arthropods undoubtedly occupy a significant position. Among the arthropod mesofauna, the acarines, some of which are of direct economic importance as pests of various agricultural crops, generally constitute about 59-95% of the total population (Murphy, 1953). Due to their profound agricultural importance and cosmopolitan nature of distribution, the acarine fauna have attracted the attention of pedobiologists, from time to time and ecological studies of various nature on them have been made on a global basis.

The acarine fauna of soils are represented mainly by the members of four orders viz. Mesostigmata, Prostigmata,
Astigmata and Cryptostigmata. Oribatid mites which are considered as an important component of Cryptostigmata occur predominantly in soil litter, humus and compost heaps. They are also found on tree trunks, in moss, lichens and similar habitats. Soil zoologists believe that these mites probably take part in the promotion of soil fertility through decomposition of organic matter. Besides their beneficial role, some of these mites are also known to produce injurious effects on higher plants by transmitting or inoculating fungal diseases.

In view of the multifaceted importance of these mites several workers made some important pedobiological investigations from time to time. The review as presented below is an attempt to bring together some of the major discoveries, being the results of such studies so far made.

In the second and third decades of the twentieth century Morris (1922), Thompson (1924) and Edwards (1929) made some investigations on the permanent pastures and arable lands, but the intensiveness of sampling in their cases was not enough to give any reliable estimate of the numbers.

Ford (1937 and '38) worked on acarine and collembolan population inhabiting tussocks of the grass Bromus erectus and found Hypochthonius pallidula as the most abundant species. According to him moisture was an important factor for the existence of acarines. Drying or wetting of the tussocks caused migration of certain species within them.
Bawjéa (1939) while working on the effect of sterilization of soil on the fauna observed a tendency of seasonal fluctuation, population-maxima being in late autumn and early winter. The fauna in sterile plots did not reach the same level as that in the control plot for approximately six months.

According to Hammer (1944 and '53) who worked on the microfauna of Greenland and Canada soil fauna were to some extent negatively correlated with soil moisture and they belonged to two communities one characteristic of damp and the other of dry habitats.

Weis Fogh (1948) while working on the mites and collembola of pasture land found that the size of some common microarthropods restricted their occurrence to upper layers of soil for small size of the pores precluded them from penetrating into the deeper layers. He reported maximum and minimum population, in autumn and in summer respectively.

Strenzke (1951 and '52) in his observations on North German soils found that oribatid mites were usually most abundant in autumn and winter and least abundant in summer. Further, he considered Tectocephus velatus as a 'plastic' species in relation to environmental factors such as water content, humus content, pH, litter cover and sodium chloride content of soil.
Riha (1951) while working on oribatids found that the desiccation tolerance of many species decreased rapidly below 7°C. According to him some species were truly fungivorous while others feeding on damp litter or faecal material containing high fungal and bacterial population.

Evans (1951) worked on the forest humus layers and observed the peak population of soil mites in autumn and winter.

Macfadyen (1952 and '54) while working on the invertebrate fauna of Finland and Jan Mayen Island soils noted the winter maxima of the population and its greater concentration in the upper layer. He also observed the phenomenon of aggregation in the microarthropod communities of soil. Later, Murphey (1953) in his work on the mesofauna and meiofauna of forest soils, also reported the greater concentration of fauna in the upper layers of soil.

Haarløv (1955) worked on the vertical distribution of mites and collembola in relation to soil structure and found that the vertical distribution of these components of soil fauna was probably related to the size and shape of the soil cavities, relative humidity and the presence or absence of food. Subsequently in 1960 he made a detailed study on the microarthropods of Danish soil in 8 different communities and observed the dependence of microarthropods on vegetation, temperature, soil structure
and other edaphological factors such as organic carbon content and acidity of soil.

Sheals (1957) analysed the quantitative composition of the acarine and collembolan population of uncultivated soils at Glasgow and studied their vertical, horizontal and seasonal distributions. In most cases the population density of 0-3 inch layer of soil was significantly greater than that in the 3-9 inch substratum. The animals were not distributed horizontally at random. He attributed the seasonal fluctuation of acarines to the variation in climatic factors.

Karppinen (1955a and b) while working on the acarine community of Finland noticed combined action of several edaphic factors affecting the soil community. According to him the tolerance range of a particular factor varied significantly from species to species.

The work of Davis and Murphy (1961) on the reclaimed soil indicated that of the different edaphological factors, pH, organic matter, soil porosity and soil moisture were relatively more important than the mechanical composition of soil and root content. In a separate investigation Davis (1963) was able to find out a correlation between the microarthropods and the edaphic factors in iron stones
quarrying district and inferred that the porosity and organic matter content of soil were the most important edaphic factors in such a habitat.

Dhillon and Gibson (1962) while working on the collembolean-and-acarine fauna of agricultural soils observed the predominance of soil faunas in upper layers. According to him neither soil pH nor moisture exhibited any significant correlation with the population density.

Madge (1964a, b and c) in a series of investigation amply demonstrated cases of physiological adaptations in oribatids, helping them to inhabit the upper litter layers. In another series of experiments Madge (1965a and b) noticed clear temperature preferences in case of some cryptostigmatid mites, in the sense that the species inhabiting more exposed sites were more tolerant of high temperature than those inhabiting the moist soils.

Block (1965) studied the bionomics of two species of oribatid mites of pennine moorland soil under subarctic climate and found a single annual generation in case of both. In an ecological study at the same site Block (1966a) observed that most of the mites occurred within the top 3 cm layer of the soil cores, being most abundant in May and December and least abundant in August. Block (1966b) made a separate study on the distribution of mites on
eroding blanket bog in northern England and observed that the fluctuation of population density was directly related to some biotic factors such as plant cover and microflora of the soil and not to soil moisture.

Rapoport and Najt (1966a) while working on the microarthropods of two places in Argentina found two different population peaks in two different months; acarines, however, dominating over other microarthropods.

Rapoport and Izarra (1966b) in their attempt to establish a relation between the rhizosphere and the soil microfauna observed larger population in the samples taken from rhizosphere than in those collected outside the rhizosphere.

Loots and Ryke (1966) in their work on the comparative study of microarthropod population in the pasture soils recorded maximum population during late summer and early autumn (end of rainy season) and minimum population during late winter and early spring (dry season). According to them, the difference in the biomass of microarthropods was not always related to the variation in the number of individuals. Subsequently, Loots and Ryke (1967) showed that the oribateli in general preferred soils rich in organic content.
Nassar et al. (1967) studied the effects of physico-chemical conditions of soil on the collembolan and acarine fauna of Egypt and was able to establish a relation between the population size and the content of organic matter in the soil. Both the groups, however, did not respond positively to the electrolytic content of the saline and alkaline soil.

Brunett (1968) while working on the effects of irrigation, cultivation and insecticides on the soil arthropods of East African dry grass land observed greater concentration of microarthropods beneath the grass clumps in the upper 7.5 cm of the soil and their steady increase with the increase of soil moisture. However, he was unable to record any significant change in the population size due to the application of insecticides.

Shackles and Murphy (1969) followed the microplot technique to study the effects of soil moisture on woodland leaf litter fauna and reported abundance of mites in the plots with higher moisture content.

Belfield (1971) made a comparative study on the arthropod population of the shaded and unshaded plots in West Africa and was unable to find out any significant difference in the population density of acarines in respect of both horizontal and vertical distribution.
In the same work he however observed a significant correlation of nitrate content of soil with the arthropod population.

Anderson (1971) made an interesting observation on the vertical distribution of oribatei in two woodland soils of England in the sense that most of the adult mites were concentrated in the litter and raw humus sub-horizon of both the plots while greater concentration of the juvenile forms were found in the humus layer.

Alicata et al (1973) worked on the distribution and seasonal fluctuation of soil oribatids from an Etna evergreen oakwoods in Italy and found that increase in density of oribatids was mostly related to the nature of aggregation, seasonal variation being due to difference in microclimatic conditions. They found maximum and minimum population in winter and summer respectively.

Price (1973 and '75) in his works on the abundance and vertical distribution of microarthropods in a California pine forest soil found that substantial proportions of all the major groups occurred below the humus layer throughout the year. According to him this type of distribution might be related to soil moisture.

In a similar observation on the oribatid mites of pine and birch forests Rubcova (1973) reported the occurrence of the highest diversity of species in fresh and humid habitats in pine stands.
According to Ghilarov (1973) 'Soil tillage and agricultural utilization affect soil animals in various ways and are to a different degree, dangerous to various taxa and ecological groups of soil invertebrates accompanied by the change of predominating species'. The elimination of many ecological groups/taxa following tillage and other procedures of soil utilization was one of his significant findings.

Edwards and Lofty (1973) while working on the influence of cultivation on soil arthropod population observed that the effects of ploughing simulated, more or less, the conditions that normally prevailed in an arable land.

According to Athias (1974 and '75) who made a comparative study on the abundance and vertical distribution of microarthropod populations in the burnt and unburnt Savanna soils of Ivory Coast, West Africa, biomass in the unburnt plot was three times higher than in the burnt plot. The predaceous and saprophageous microarthropods were predominant in the unburnt Savanna whereas relatively more phytophagous microarthropods were observed in the burnt plot. The density of population in both cases was found to be the highest in the first 20 cm of the soil profile.
Nakamura (1974) worked on the effects of inorganic fertilizers (calcium and phosphate) on soil microarthropods of a grassland ecosystem over a period of three years and observed that the composition of species was more or less similar in controlled as well as treated plots in the first year. But in the third year the composition of species in the treated plots became more complex, perhaps due to the impact of fertilizers used.

Marshall (1974) who studied the seasonal and vertical distribution of soil fauna in a thinned and urea fertilized Douglas fir forest of Canada observed a significant downward seasonal distribution of mites and collembola due to urea treatment while the total population being composed of different groups remained unaffected.

Usher (1975 a and b) while working on the cryptostigmatid population of pine forest soil in Scotland reported a strong tendency of aggregation of these mites, most of the forms exhibiting a single peak though not synchronised in many cases. The cryptostigmatid community showed a vertical stratification being more concentrated in litter layer and fermentation horizon, and a natural tendency of vertical migration during the periods of drought and winter.
Tadros (1975) in an attempt to establish a relation between the occurrence of oribatids and soil fungi in Qualubia Governorate in Egypt reported the occurrence of some moss mites in association with some fungi in different strata. According to him the fungi *Aspergillus* spp. and *Trichoderma* spp. served as food for the mites *Oribatula tadrosi* and *Protoribates* sp. while the deeper fungal flora viz. *Penicillium* spp. and *Rhizopus* spp. acted as suitable nutrients for the oribatids like *Lohmannia* sp. and *Eulohmannia* sp. Subsequently, Tadros (1976) while working on the role of soil fauna on the decomposition of organic matter observed some positive role played by the acarines in the process of decomposition of organic matter.

Thus, we witness from the different parts of the world; specially Europe, United States and Latin America the persistent pouring of literature concerning autecological as well as synecological studies on the soil arthropods including the acarines. The gradual accumulation of such literature has been possible because the biologists working in those parts of the world are fully aware of the academic and practical utility of such studies. In contrast to this in India the research contribution in respect of ecology of mites in general and
of oribatids in particular are negligible despite their abundance in different habitats. Whatever little information is available in this respect is mainly due to some sporadic efforts made by Mukherjee and Singh (1967, '70, '71 and '73), Raychaudhuri et al. (1972, '73 and '74), Bhaduri and Chakrabortty (1972), Choudhuri and Banerjee (1975, '77), Singh and Pillai (1975), and Prabhoo (1976). Therefore, more intensive investigation for obtaining a comprehensive and better picture as to the ecology of mites inhabiting tropical climates of India seems to be an unavoidable academic necessity. It is in this context that the present investigation has been undertaken to ascertain (1) the nature of oribatid population inhabiting the cultivated and uncultivated soils, and also the forest soils of four districts of West Bengal having identical or different soil conditions, and (2) the effects of various edaphological factors viz. temperature, moisture, pH, phosphate, nitrate and organic carbon on the population-size and distribution of oribatids. Greater emphasis has, however, been laid on the second objective for on this issue there exists large disagreement amongst the findings so far reported. Attempts have also been made in this work to verify the authenticity of the observations made by Banerjee (1972) by taking samples from the
same plots and finally to make a generalization as to the probable causes of population fluctuations by taking into account the results of this investigation along with those reported by earlier workers.