I. 1. INTRODUCING THE PROBLEM

The most exciting phenomenon of this world is its variety, bio-diversity. Of this none is more interesting than that displayed by man. Though in the beginning, the path of enquiry into this diversity was directed towards understanding the behavioral pattern of man with some philosophical overtones in approach and in interpretations, later they were concerned with understanding hereditary differences of individuals, population and races. The enquiry led man to the discovery of the laws of heredity and the mechanics of its operation and their underlying molecular basis, which now broadly constitutes the science of genetics.

Genetics influences human society in its various aspects. Genetic studies deal with heredity and variations among organisms. Genetics has its most important application to practical problems and also its most direct bearing on evolutionary theory. The heritability of a metric character is one of its most
important properties. It expresses the proportion of total variance i.e. attributable to the average effects of genes and this is what determines the degree of resemblance between relatives. In case of heritability only the phenotypic values of individuals can be directly measured, but it is the breeding value that determines their influence on next generation. Hence the heritability is defined as the ratio of additive genetic variance to the phenotypic variance \( h^2 = \frac{V_A}{V_P} \), where \( h^2 \) stands for heritability, \( V_A \) for genotypic variance and \( V_P \) for phenotypic variance (Falconer 1981). Heritability can be studied for different human traits – like dermatoglyphics, blood groups congenital diseases etc through pedigreed populations.

Population genetics, a branch of genetics, in particular is the study of genetic composition of populations and laws of principles, which govern those compositions. Understanding the physical evolution of man is one of the prime concerns of population geneticists. Evolution in a general sense, involves the study of changes in gene frequencies both in space and time, brought about by various evolutionary pressures namely selection, mutation, drift and migration. This requires information on the gene frequencies in various extinct, historical and the present populations distributed under various environmental conditions. The study of extinct and historical populations was made possible from whatever known from available human fossils and some primitive isolated societies, which lived under more or less similar historical environmental conditions.

For many years population geneticists used gene frequency data to understand the evolutionary differences of human races. Later it was realized
that comparisons of frequencies of a few loci may not be reliable, but a large number of loci have to be considered to understand the genetic diversity or relationship. However, a large number of workers attempted to study the modern population diversity considering at a time several traits that characterize their differences. Dermatoglyphics is one such a field that comprise several traits, and the study of dermatoglyphic traits in a population may be more useful in understanding its genetic diversity, in view of the high genetic component in the inheritance of several of these traits.

Dermatoglyphics, which was originally known as hieroglyphics, is a field of study, which deals with the details of dermal inscriptions on palm and soles of primates and man. The study of dermatoglyphics though ancient, developed a scientific basis only after the study of Purkinjee in 1823, which brought about a systematic classification of finger print patterns. And it is the work of Cummins and Midlo (1943) that has turned the attention of the biologists towards the importance of dermatoglyphics in biological investigations. They discussed in detail the historical background, methods, description and the fundamental biological phases of dermatoglyphics including inheritance.

Dermatoglyphics constitute the traits that define the type of configurations on the skin of the palm and soles like the ridges and lines, the tri-radii, etc. (Holt, 1968). These configurations are supposed to be differentiated in the third and fourth months of foetal life under the influence of intra-uterine fluid pressure (Mulvihil, 1969). Thus a pattern like a whorl or a loop or the number of ridges between the core of a pattern and tri-radii are most
likely to remain the same throughout the life. Any distortions of these ridges could only be due to the intra-uterine environment, and the ridges are insensitive to the postnatal environmental changes.

Epidermal ridges are modified scales primitively imbricate in arrangement. Each scale is associated with one hair or groups of hairs and a sweat gland. In course of evolution, the hairs disappear and scales aggregate into ridges. The evolution is traced only in primates by Whipple (1871-1929). Prosimians, the lowest primate group affords a good illustration of progressive stages of ridge formation. The Prosimians, unlike man, apes and majority of the monkeys, exhibit large areas in which the ridge formation is incomplete. The pads bear fully developed ridges, other regions displaying structures designated by Whipple as epidermal warts or epidermal rings. The probable evolutionary steps are better exemplified in lemur. There the incomplete ridges are represented by minute elevations-warts (islands), each bearing in its centre the orifice of a sweat gland. Epidermal rings are formed by conglomerations of these warts. Continuous long ridges result from fission of extremities of elongated rings. Some primates lack rings, but the warts gather in lines which are prospective ridges. The transition from warts to rings and from either of these two to long ridges is not continuous sequence in the developmental history of man, because ridges develop in man without passing through these steps. The minutiae of non-human primates are comparable to human hand and foot.

The ridged skin of palmer and planter surfaces, also known as friction skin, characterizes all primates and sometimes sporadically occurs in some
Quadrupeds (cat & dogs) do not possess dermatoglyphics. When present it is associated with erasing function: in no way it is connected with systematic classification. Among rodents, field mouse possesses prominent pads without dermatoglyphics. But the common squirrel has some pads, partially covered by ridges. In insectivores, it is poorly developed. Hedgehog and tree shrew possess patches of ridged skin. Most carnivores lack it, though in some forms as in kinkajun of South America, the development of ridged skin is fairly advanced. The marsupials are widely variable. Some do not have, others like tarsipes display ridges over pads. Marmosa has more extensive ridged skin and in phalanger, the sole is completely covered with ridges. No primates lack at least some ridge bearing areas, but specialization varies in this group. Among primates some New World monkeys including marmosa, howler, night monkey, spider monkey and capuchin monkey – there is considerable diversity. In some, pad surfaces presenting only islands and short ridges, others exhibit incomplete ridge formation in the central portion of the palm and sole. Continuously ridged skin is characteristic in other New World monkeys, in Old World monkeys, in apes and in man.

The study of dermatoglyphics in man dates back to the end of 19th century, when the importance of fingerprint patterns gained ground in many quarters, notably in India, Japan, Argentina and U.K.. Sir William Arschel in India, Henry Fauld in Japan established the individuality and uniqueness of fingerprints to be used as important tool in criminological investigations. Francis Galton (1822 - 1911) demonstrated the hereditary significance of fingerprints and showed the biological variations of different fingerprint patterns amongst different racial groups. Galton was the first to put forward a
classification of fingerprint patterns which was simpler than that proposed by Purkinjee.

After Galton's pioneering work, many further investigations were undertaken to develop this fledging science of dermatoglyphics. However the main breakthrough in establishing the significance of dermatoglyphics came with the work of Harold Cummins and Charles Midlo in 1943. And it was they who in fact coined the term dermatoglyphics (derma - skin, glyphe - carvings) in 1926. They also researched the embryogenesis of skin ridged patterns and established that the fingerprint patterns actually develop in the womb and are fully formed by the fourth foetal month. Dermatoglyphic analysis is now beginning to prove itself as an extremely useful tool for preliminary investigations into conditions with a suspected genetic basis.

Inspired by Cummin's and Midlo's work, L.S.Penrose in 1945, conducted extensive investigations into chromosomal disorders and their dermatoglyphic manifestations; considering not only the more common trisomies, such as Down's syndrome, Edward's syndrome and Patau's syndrome, but also initiating investigations into other more rare chromosomal disorders such as Cry-du-Chat Syndrome and the sex chromosome disorders – Turner's syndrome and Klinefelter's syndrome. Penrose (1966) formulated the measurements to establish the position of the displaced axial tri-radius in terms of 'atd' angle. Sarah Holt, one of the Penrose's assistants published the book Genetics of Dermal Ridges in 1968. From then onward much research was carried out on establishing the statistical distributions of dermatoglyphic patterns of both the fingers and of the palms, in various people, both normal
and congenitally affected. In addition to giving further confirmation of the genetic and chromosomal bases of dermatoglyphic patterns and investigating the manifestations of these in chromosomal disorders, other investigations focused on which dermatoglyphic features are in fact inherited and how inheritance might be detected.

Although many important discoveries regarding the psychological significance of finger patterns have been made, the main thrust of scientific dermatoglyphic research, in the later half of the 20th century has been directed towards genetic research and the diagnosis of chromosomal defects. Significant investigations have also been carried out into the dermatoglyphic indicators of congenital heart disease, leukemia, cancer, coeliac disease, intestinal disorders, rubella embryopathy, and Alzheimer’s disease, schizophrenia as well as other forms of mental illness.

The modern study of hand is thus far removed from the popular image of the soothsaying hand readers uttering mysterious incantations in an arcane language. Rather through decades of scientific research, the hand has come to be recognized as a powerful tool in the diagnosis of psychological, medical and genetic conditions.
1.2. REVIEW OF LITERATURE

The first known observations of dermal ridges were made by Nehemiah Grew (1641-1712) who wrote in the *Philosophical transactions* of 1684—"For if any one will but take the pains, with an indifferent glass, to survey the Palm of his Hand, very well washed with a Ball, he may perceive innumerable little Ridges, of equal bigness and distance, and everywhere running parallel with one another and especially upon the ends and first Joints of the Fingers and Thumb upon the top of the Ball, and near the root of the Thumb a little above the Wrist. In all which the places, they are very regularly disposed into spherical Triangles and Elliptics. Upon these Ridges stand the Pores, all in even Rows, and of that magnitude, as to be visible to a very good Eye without a Glass". Marcello Malpighi (1822-1911), a contemporary of Grew, made some passing references to the papillary ridges arranging themselves as patterns. In 1823, John Purkinjée (1787-1869), submitted a thesis on fingerprint classification, but little notice was taken of his work at the time. It was left to three great Englishmen — Sir Francis Galton (1822 – 1911), Sir William Herschel (1833 – 1917) and Sir Edward Henry (1859 – 1931) to produce the fingerprint system now used throughout world. By 1901, fingerprint identification was practised in England, replacing Bertillon’s anthropometric methods of personal identification (David, 1971). Francis Galton, the cousin of Charles Darwin was a scientist with a wide range of interests covering anthropology, geology, biology, heredity and eugenics, publishing some 240 written works including some fifteen books. He conducted extensive research into the significance of skin ridge patterns, not only to demonstrate their permanence and consequently their use as a means of identification, but also to
demonstrate the hereditary significance of fingerprints and to show biological variations of different fingerprint patterns amongst different racial groups. His two works *Fingerprints* (1892) and *Fingerprint Directories* (1895) are rightly considered as classics in the field of early dermatoglyphic research and stimulated the interest of all sorts of scientific investigators, such as anthropologists and zoologists as well as geneticists and criminologists.

The word “dermatoglyphics” which literally means the patterns formed by the epidermal ridges of the skin (derma = skin, glyphe = carve) was coined and was given a second meaning by Professor Harold Cummins in 1926, who used the word to describe the study of these patterns on the fingers, palms, soles and toes of humans as well as certain higher primates. The main thrust of their research was into Down’s syndrome (also called mongolism) and the characteristic hand formation it produces. They showed that the hand contains significant dermatoglyphic configurations that would assist the identification of mongolism in the newborn child and thus they set the stage for much of the later dermatoglyphic research work.

Our understanding of dermatoglyphic ontogeny is based on a number of studies of the embryological processes of ridge differentiation and volar pad regression. The early work of Bonnevie (1926), Cummins (1926,1929), Abel (1938) and Hale (1952), laid the foundation for later studies of Chacko and Vaidya (1968), Holt (1970), Penrose and Ohara (1973), Okijima (1975,1979) and Babler (1978, 1979). The work of Penrose (1963, 1965, 1969, 1979) in which he developed the theory of dermatoglyphic topology is also important in this context. The hypothesis, which has emerged, interprets pattern form as a
reflection of the topography of the volar surface at the time of ridge differentiation, while ridge count is thought to measure volar pad elevation.

The use of fingerprints for personal identification became widespread early in the 20th century. How the fingerprints slowly become standardized involves many persons— including Nehemiah Grew, Johannes Purkinje, William Herschel, Henry Faulds, Charles Darwin, Francis Galton, Mark Twain, Juan Vucetich, Edward Henry, and J. Edgar Hoover. Although fingerprints have been noted and used since antiquity, a 25-year burst of activity that secured adoption of their use for identification began in about 1880. New modifications and applications have continued to the present. This history of fingerprints includes a bitter struggle also for appropriate credit for various crucial steps in developing and adopting this crucial important tool. The analysis of finger and palm prints as a means of personal identification has become well established since the initial development by Sir Francis Galton in 1890’s (1891, 1892, 1893).

The choice of dermatoglyphics as the character analyzed is due to their biological characteristics. Quantitative traits are considered to show “selective inertia” (Rudan 1975, 1982; Rudan and Schmutzer 1976; Milicic et al. 1985) and according to Rudan, Sinic and Bennet (1988) — “These traits are less influenced by current evolutionary factors and migratory processes and thus distances estimated from the dermatoglyphic data are the last estimate of the differences that did or did not exist in the ancestral population”. The quantitative approach during the decades as reflected in the literature has generated fresh interest in the field of dermatoglyphics. Of the various quantitative
dermatoglyphic traits, the Total Finger Ridge Count (TFRC) has received major attention. TFRC, a quantitative variable, is fixed during the first half of foetal life, (Cummins and Midlo 1943). Although the TFRC has high genetic component, about 95% (Holt 1952), the mean ridge count is higher on the right than in the left hand (Holt 1954). Furthermore the count is higher in males, than in females although the variance is greater in females. A number of early studies revealed marked variation in this trait among the major ethnic groups of man (Book 1954, Holt 1955, Matsunga et al. 1970, Rothhammer et al. 1973, Weninger et al. 1976).

Variability of finger ridge counts among populations representing various geographic, ethnic and racial groups, has been engaging the attention of researchers in dermatoglyphics for the past two decades. It has been realized that summary measures such as TFRC/ATFRC are not adequate in tracing population relationship and that a multivariate approach is needed to study finger ridge counts. Following this realization, many others have carried out multivariate analysis of finger ridge count data (for example, Knussman 1967, Chopra 1971, Jantz and Oosley 1977, Jantz and Hawkinson 1979, 1980; Jantz et al. 1982, Arrieta et al. 1987, Krishnan and Reddy 1992). One of the most interesting and useful result of these studies has been the demonstration of the universality of a fairly clear tripartite division of digits observed by Siervogal et al. (1978); Reed et al. (1978; Meier (1981), Santos et al. (1990) and others. This division consists of - digit 1; digits 2 and 3; digits 4 and 5. Digit 4 is unstable, sometimes appearing with 5 and sometimes with 2 and 3.
Dennis (1977) extended Finger Pattern Ridge Counting (FPRC) technique to Palmer Pattern Ridge Counts (PPRC). The implied meaning of PPRC is that it is analogous to FPRC. Clearly PPRC has nothing whatsoever to do with the palmer patterns, not even interdigital patterns. Instead it is a measure, which simply conveys interdigital triradial distances expressed in terms of ridge counts. In contrast, FPRC/TFRC is a measure of the size of the patterns of fingertips. These two measures have therefore nothing in common and not comparable. Any measure on palms comparable to TFRC undoubtedly has to be based on ridge counts of the palmer patterns as introduced by Malhotra et al. (1981, 1982). The Total Palmer Pattern Ridge Count (TPPRC) is the sum of the ridge counts of all areas of both palms of an individual. In measuring population affinities, palmer dermatoglyphics has emerged as better discriminators than finger ridge counts as suggested by Jantz and Chopra (1983); Kamali et al. (1986); Reddy et al. (1988) and supported by Demarchi et al. (1997). It is customary to mention that Holt’s method of ridge counting; Loesch’s topological classification and Malhotra’s method of counting palmer ridges vastly expanded the field of dermatoglyphics.

The importance of dermatoglyphics is due to their biological characteristics and to the fact that they are genetically determined (Pons 1964, Holt 1968, Pons 1979, Juberg et al. 1980, Harvey and Suter 1983, Hrezko and Ray 1985, Chakravorty 1991, Chatterjee and Mukherjee 1991, Arrieta et al. 1992, 1993, Jantz and Brehme 1993 and Pechenkima 2000). Numerous investigations using qualitative method, demonstrated that dermatoglyphic configurations are controlled by heredity. However these methods failed to establish the mode of genetic mechanism involved. Genetics of finger patterns
using quantitative ridge counting method have been extensively studied. A series of genetic studies by Holt (1952, 1956, 1958, 1968) have established beyond doubt that the size of the patterns on finger balls are strongly determined by heredity and that patterns are controlled by almost additive polygenes.


An understanding of the genetic basis of dermatoglyphic traits has directed the dermatoglyphic research towards finding out its association with various chromosomal, genetic and clinical disorders. A review of previous works reflects on the growing interest in this field. The behaviour of dermatoglyphic traits were studied mostly in the cases with chromosomal aberrations like – Down’s, Edward’s, Patau’s, Klinefelter’s and Turner’s syndromes (Uchida et al. 1963, Penrose 1963, Holt 1968, and Penrose 1969). Correlations of dermal configurations with common diseases were also reported in cases like – Schizophrenia (Chetter, 1966; Grace and Nirmala, 1990).
1968); Leukemia (Menser and Purvis Smith, 1969; Rosner, 1969 and Nora et al., 1969); Indian childhood cirrhosis (Chandra, 1969); Rubella teratogenesis (Purvis et al., 1969); Congenital heart diseases (Puri et al., 1971); Congenital malformations (Uchida and Saltan, 1963 and Subhadra, 1972), etc. Various aspects in the genesis of dermatoglyphics were also reported by Mulvihil (1969). Of late dermatoglyphic characters are being used in determination of genetic distances (Loesch and Lisiewics, 1978).

The expanding prospects of dermatoglyphics on medicine and pathology have been studied by Garroto and Plato (1991) and Wertilechi (1991). The anomalous flexion creases reflect the altered shape and function of hand and foot which in turn are determined during early foetal development and affected by factors interfering with normal embryogenesis – intra-uterine disturbances (Schaumann and Kimura 1991). The dermatoglyphic characteristics of subjects with refractive errors, when compared with control groups, revealed significant differences in both qualitative and quantitative parameters. The loops are increased in male myopics, the whorls are increased in male hypermetropics and astigmatic, arches are decreased in all types of refractive errors in males (Chatterjee and Mukherjee, 1991). Dermatoglyphic features are used in diagnosis of periodontal diseases (Xilmaz et al., 1993). Association of finger patterns with higher systolic blood pressure was detected – greater the number of whorls, higher the systolic pressure. Whorls on right hand are more strongly associated with higher systolic pressure than whorls on the left (Godfrey et al., 1993). Congenital absence or unusual patterns of human dermatoglyphics occur in several syndromes that are rare and poorly understood. The abnormalities of dermatoglyphics fall into four categories- complete absence, ridge hypoplasia,
ridge dissociation and ridges-off-the-end. Complete congenital absence of ridges is an exceedingly rare syndrome that consists of neonatal blisters and milia, adult traumatic blistering and fissuring, absence of sweating, contracture of digits and absence of dermatoglyph on the hand and foot. The syndrome is inherited as an autosomal dominant pattern and only two kindreds have been described in the literature (Limova et al., 1993). Association of dermatoglyphics with hand anomaly (ectrodactyly, syndactyly, polydactyly, brachydactyly etc.) is very common (Watanabe et al. 1994). Association of digital pattern types with visual, auditory and mental insufficiency has recently been studied by Tornjova (1994) among Bulgarian children. Association of dermatoglyphics with cancerous diseases (Polzik et al., 1994); with maturity onset diabetes (Ravindranath, 1995); with hypodontia (Atasu and Akyuz, 1995); with celiac diseases (Tahaunt et al., 1997); with Turner's syndrome (Kobyliansky et al., 1997); with multiple sclerosis (Supe et al., 1997); with borderline personality disorder (Jalovac et al., 1998); with cerebral palsy (Simsek, 1998); with schizophrenia (Bracha et al., 1992, Jalovac et al., 1998); with psychosis (Rosa et al., 2000) also have been observed. Association of finger and palmer dermatoglyphics with Downs’s syndrome have been observed and confirmed long back, recently association of Fluctuating Asymmetry (FA) of dermatoglyphic traits with Downs’s syndrome is observed (Mginet and Ivanov, 1993, Tha et al., 1998 and Katzenelson et al., 1999).

Though dermatoglyphic characters remain unchanged from birth till death, but examination of dermatoglyphics in people aged 50 – 103 years living in the territory of the Ukrainian Palesie has revealed age differences in some indices of dermatoglyphics – total crest count, palmer angle, character of
Dermatoglyphics have been used extensively to characterize human populations and to assess biological affinities among them (Jantz et al., 1982, Arrieta et al., 1987, Crawford and Duggirala, 1992). Several studies have demonstrated that these phonic markers are conservative with respect to plastic environmental influences and stochastic process of evolution (Frochlich and Gites, 1981, Milicic, 1990). Therefore they could be useful tools on the reconstruction of prehistoric human relationships. Cummin's pioneering work in establishing the racial variability of dermatoglyphics is shown in a series of studies e.g. Dermatoglyphics of European Americans (Cummins & Midlo, 1926) of the Jews (Cummins and Midlo, 1927), of Negros of West Africa (Cummins, 1930b), of the Indians of South Mexico and Central America (Cummins, 1930a); of the Comanche Indians (Cummins and Goldstein, 1932); of the Siamese (Cummins, 1934); of the Eskimos of Point Burrow (Cummins 1938 a); among the Dutch family series (Cummins & Steggarta, 1936a); of the Maya Indians (Cummins, 1936b) and many more. The value of dermatoglyphic traits in revealing regional heterogeneity was demonstrated by Abel (1935) and Poll (1937) using various samples from a German population and by Roberts and Coupe (1972) from a population of South Midland of England.
Dermatoglyphics continue to be important in population studies (Jantz and Chopra, 1983). Towards the end of twentieth century, the application of dermatoglyphic traits (finger and palmer) in population study was gaining ground in almost all quarters of the world. Different investigators carried out investigations in different populations. For example – in N.E. Brazilian population by Krieger (1969); in South American tribal populations by Rothhammer et al. (1979); in rural populations of Island of Hver, Croatia by Rudan (1975, 1982); among Greeks by Bartoscas et al. (1982); among indigenous New Guinea groups by Lin et al. (1983); among Faroe Islanders by Micle (1986) and Micle & Kobyliansky (1986); among Bulgarians and Easter Islanders by Karev, Harvey, Goodman and Meier (1986); among rural population of Poland by Loesch (1986); on Baskirs by Dolinova et al. (1986); on Spanish population by Martin and Purtabales (1986); on Iranian population by Kameli et al. (1986, 1988, 1990); among seven minority nationalities of China by Zhang et al. (1989) and among Basque populations by Arrieta et al. (1987, 1990, 1992, 1993). Studies were carried out among Amerindians of Costa Rica (Quesada and Barrantis, 1991); among Czech population (Kuklik, 1991); among Hungarian population (Gladkova, 1991), among population of Ireland (Greally et al., 1991). Finger dermatoglyphics in Delta de l’Ebre: a Mediterranean Spanish population were studied by Arquimban (1993) and among 5 Lapp samples of U.S. were studied by Jantz et al. (1993). Dermatoglyphic studies among Mataco and Pilaza Indians of Gram Chaco and Araucanian Indians of Patazia, Argentina were carried out by Demarchi et al. (1994, 1995, 1996, 1997). Martin and Gomez (1993) showed absence of sexual dimorphism in respect to finger ridge count. Further studies involve – correlation of ridge count distance and geographic distance among Europeans.
(Jantz 1997); digital dermatoglyphic comparison between Moroccan Arabs and Mediterranean population (Kandil et al. 1998); among Croatians (Letini and Milicic, 1998); among Malawi’s and among Rhodopsians of south Bulgaria (Igibighi & Msamati, 1999; Kavgezova, 1999). Biological affinities among 17 South American aboriginal populations are examined by means of multivariate analysis of dermatoglyphic traits (Demarchi & Marcellino, 1998). Females have more ridge density than males, it is observed in Croatian of African American sample (Acree, 1999).

In India the studies on finger dermatoglyphics dates back to 1950. The first work was done by Singh (1950) on Punjabi Sikhs, by Deol (1950) on Punjabi Hindus and by Singh and Deol on Rajputs and Koltas of Jaunsar district U.P. Next to Singh and Deol, studies on finger dermatoglyphics were carried out by Datta (1954-1955), Saxena (1955) and Mehta (1955-1956) in Himachal Pradesh, Biswas and Verma (1952), Singh (1955) in Punjab. Geographic and ethnic variability of finger ridge count was studied by Krishnan & Reddy (1994). Uttar Pradesh being the state with highest finger dermatoglyphic work (1950-1987).

On palm dermatoglyphics also highest work was done in Himachal Pradesh, U.P. Palmer dermatoglyphics of different populations of India have been studied by different scientists at different periods. For example on Rajputs of Monali Kulu (Singh 1955); on Brahmins,Rajputs and Artisans of Monali Kulu, Himachal Pradesh (Dhengra 1955-1956); on Koltas of Jaunsar district U.P. (Dhawan 1955); on Bhutias of Almora district, U.P. (Tiwari 1955). The first work on palm ridge count was done by Datta (1961b) on Andhraite
males, in which only a-b ridge count was studied. Newman (1960) utilized the dermatoglyphics for the study of population variation among Maya Indians. Following Newman in India, Singh (1961), Srivastava (1962) and Bannerjee (1970) utilized dermatoglyphics to find out biological distance between some of the caste groups of Uttar Pradesh and Bengal respectively. Most of the work on palmer ridge count was done by Bhasin (1966, 1970, 1971) and Bhasin et al. (1984, 1986) on Bhutanese, Newars of Nepal; Lepsas, Bhutias, Sherpas, Sherpas and others of Sikkim; and on different castes of Himachal Pradesh. Quantitative palmer dermatoglyphics and assessment of population affinity was studied by Reddy et al. (1988). Segregation analysis of palmer triradii was studied by Gillian et al. (1987). Dermatoglyphic affinities among Fisher man of Puri Coast and among Telegu population also was studied by Reddy et al. (1990, 1992). Two compilations of the various studies of dermatoglyphic traits among the people of Indian origin have been published by Singh and Bhasin (1979) and Bhasin et al. (1992).

North East India is the homeland of various people belonging to different ethnic groups, having different socio-cultural heritage. The dermatoglyphic research in N.E. region of India has been increasing voluminously and its approach in understanding the ethno-biological relationship has received well attention and the contributions made by different scholars in this particular field definitely are commendable. The first work on finger dermatoglyphics was done by Bhattacharjee (1955) on Abor tribes of Assam. Finger dermatoglyphics of various tribes and castes of the then Assam and present day North East India, like Abor, Mishing, Garo, Rabha, Lalung, Kachari, Rajbongshi, Kumar, Ahom and Kalita were studied by various
scholars (Bhattacharjee, 1955; Das and Deka, 1958; Das 1960, Chakravorty and Mukherjee 1961, Das and Bhagawati 1962, Das and Das 1965, 1965b, 1966, 1972; Das and Sengupta, 1972; Das et al. 1985, 1986). Das and Das carried out studies on finger ridge count of the Khamyang – a mongoloid population of Assam. Dutta (1977) and Dutta (1983) carried out studies on Dollas and Ahoms of Assam. Dermatoglyphic studies of four caste groups – Yogis, Hiras, Kumars and Kaibartas and separately on Kalitas were carried out by Das et al. (1986). Finger and palmer dermatoglyphic variation among some Assamese castes was studied by Srutikar (1987). Dutta and Sengupta (1994) carried out studies on finger dermatoglyphics on Sonowal Kachari of Dibrugarh, Assam.

The Muslims of India present a unique opportunity for population genetic studies. Although Muslim is supposed to be one community, a number of groups which are by and large endogamous, prevail among Muslims. In the dermatoglyphic field very few studies were carried out on Muslim population of India as well as of Assam. The dermatoglyphic traits of following populations are studied so far – Muslim male of Basti district of U.P. (Singh, 1961); Muslims of Kashmir (Sen 1968); Moria of Lakhimpur district, Assam (Srivastava, 1969); Muslim males of Jalpaiguri and Nadia district of West Bengal (Sarkar 1969, 1972); Sunni Muslims of Pachmari district of M.P. (Wadhwa 1972, 1973; Sarma 1972); Sunni Muslims of Pachmari district of M.P. (Sarmah, 1972). Parsis of Gujarat and Hyderabad (Banerjee 1976, 1981); Goria and Moria Muslims of Dibrugarh (Das 1980); Parsis of Gujarat (Pal et al. 1982); Parsis of Gujarat (Pal et al. 1982); Mysore Muslims (Basu 1983b); Muslim Gujars of N.W. India (Balgir and Sarmah 1986) and Shia and Sunni
Muslims of India (Joshi 1987). The vast field of Muslims of Assam is yet to be fully explored.

The utility of dermatoglyphics in local population studies derives from their strong genetic determination, lifelong stability, absence of environmental influence and apparent lack of differential selective advantage (Hanser, 1986); their analysis gives a different perspective on local population structure and relationship and provides a dimension that is largely independent of those of serological polymorphism, anthropometry and other variables.
1.3. OBJECTIVES OF THE STUDY

HYPOTHESIS

Dermatoglyphic patterns are highly polymorphic. No two individuals are known to resemble each other. Even monozygotic twins are known to show variation. Little is known about the inheritance of such patterns. In order to arrive at a better understanding of the mechanism leading to the formation of these configurations, it seems logical to assume that the configurations of palms and fingers must have something to do with their sizes and shapes. It is more logical that a longer palm might have smaller ‘atd’ angle than a broader palm. Similarly the ‘t’ to ‘d’ ridge count could be much more in a longer palm than a shorter palm. One may similarly like to imagine that the ridges on the palms and fingers may be laid more in number when these have a greater surface area.

OBJECTIVES

The Indian population, which seem to have been studied to a considerable extent, in the sense of understanding genetic diversity or relationship, is unique in its structure being divided into various castes, sub castes, exhibiting morphological heterogeneity and providing opportunity to study, understand and predict the mechanism of social and physical evolution of man in time and space. Even the individual castes have undergone such
social and genetic differentiation over time that the study of any single caste could provide valuable insights into population structure.

Studies on population diversity in terms of genetic markers are being pursued for quite sometime. Several populations have been studied for dermatoglyphic features. In Assam also lots of studies have been done to understand the genetic variation between different population groups. The Muslim population is, however, very little studied in this respect. Das (1980) studied the biological affinities between Hindus and Muslims of Dibrugarh district in respect of somatometric traits, ABO blood groups and finger patterns. Das et al. (1985) studied the distribution of finger ridge patterns and indices in Muslims of Brahmaputra Valley. However, the Muslims of Lakhimpur district have not yet been studied in respect of any genetic marker.

The present study, therefore, aims at examining the following:

i. The variation between the three sects of Muslims i.e. the Syeds, the Gorias and the Morias in respect of ABO blood groups and colour blindness.

ii. The variation between the three sects in respect of finger pattern, palmer pattern, finger ridge count, pattern intensity index, palmer ridge count and atd angle.

iii. The heritability of finger pattern, finger ridge count, pattern intensity index, a-d ridge count, t-d ridge count and atd angle.
iv. Correlation between finger ridge count and the surface area i.e. width and depth of the fingers.

v. Correlation between the a-d and t-d ridge counts of the palm.

vi. Correlation between atd angle and palm length and palm breadth.

vii. Correlation between total finger ridge count and a-d ridge count of palm.

viii. The association between ABO blood group and finger patterns.