Chapter-5

SUMMARY AND CONCLUSIONS

Complete, Partial, Smudged and Fragmentary Finger Prints collected from 100 individuals (57 males and 43 females) on different type of papers have been analysed for the First Level (Pattern type), Second Level (Galton Details/Minutiae’s) and then the Third Level (Poroscopy and Edgeoscopy) to set a standard for the Third Level characteristics for individual identification.

Very often the fingerprints recovered from the scene of crime are partial, smudged and fragmentary or imperfect i.e. the crucial number of ridge characteristics is not available. It is a great handicap for the experts to give opinion on identify in such cases.

In order to overcome the handicap there is the great need to include the third level details, besides the first and second level details. The third level details include the number, shape and relative position of sweat pores, (Poroscopy) and shapes of the edges of ridges (Edgeoscopy).

The detailed description and make of different type of papers selected for taking the finger print samples are as follows:

**Ordinary Paper A** (BILT Copy Power)

Based on the whitest reflectance of Ordinary Paper A is selected over paper B and Paper C and is most suitable paper for color reproduction as it is neutral and all colors printed on it will be in color and gray balance. Colors printed on paper B will appear bluish; colors printed on Paper C will appear yellowish or reddish.

**Executive Bond paper** (BILT Royal Executive Bond)

Royal Executive Bond, a premium range having watermark business stationery paper has commanded a leadership position in the market since its inception in the year 1999. This is a product of Ballarpur Industries Ltd (BILT).

**Glazed Paper** (Infinity Industries Private Limited)

Paper with high gloss or polish, applied to the surface either during the process of manufacture or after the paper is produced, by various methods such as friction glazing, calendaring, plating or drying on a Yankee Drier.

After selecting different types of papers, the finger prints with different inks were taken as follows:
Standing at a forearm length from the paper the subject was asked to give the prints. Ink was applied evenly in one direction over the distal phalange of right index finger of the subject and then prints were taken on all the three types of paper. Complete prints were taken from the right index finger at a time on one paper so as to facilitate comparison and the process was repeated to take partial and fragmented finger prints. The papers were labeled properly with the sample number (say sample no. 1) which corresponds to the donors’ details (name, age and sex). Prints were stored carefully in a sequence so that they could be taken out easily whenever required for comparison and analysis.

Since pores present on the ridges are largely affected by pressure and external factors effort has been made to obtain finger prints from the subjects under uniform conditions including pressure as far as possible. Edges of the ridges were found to be comparatively less affected in all the prints taken on different papers with different types of inks.

The following observations related to the effects of different types of papers on the impressions were made:

It was observed that the spreading of ink was less in Executive Bond paper in comparison to the ordinary paper (A) which may be due to higher density of fibers in paper; no spreading of ink was observed in Glaze paper.

The stability of the prints was better in Executive Bond paper in comparison to the ordinary paper due to the better quality of this paper (higher density) than ordinary paper and in case of Glaze paper it was less as compared to the ordinary paper and executive bond paper possibly due to the glazy surface.

**Effect of different types of ink (printer ink and stamp pad ink) on the impressions**

Prints taken with Printers ink (Kores and Sirchie) were better and clear than the stamp pad ink and it provides more points for comparison under identical situations. Prints obtained with Sirchie ink were still better then Kores printers’ ink particularly when third level details are required. In some of the prints pattern of the stamp pad net was also observed which affected the clarity of the prints.

**Variations in the edge characteristics**

There are some degrees of variations in the appearance of third level details in the fingerprints taken on ordinary, executive bond and glaze paper were studied in all the samples.
These variations were clearly visible in photomicrographs, which may have occurred due to any one or combination of the following reasons:

- **Pressure applied**
- **Less or excessive amount of ink used**
- **Some foreign materials**
- **Surface debris on the finger**
- **Irregular surface**

In the Present Study, the photomicrograph of Fragmented finger print was prepared and then the number, size, shape and relative positions of sweat pores per photomicrographs were studied in all the samples of 100 individuals. The results of these parameters are given as follows:

1. **Number of pores:** It was observed that the number of pores present in the photomicrograph ranged from 5-8 and average per photomicrograph is 6 (Table-2).
2. **Size of pores:** In the present study, the size of pores was classified as small, medium and large, but was not given much importance as their size varies with the above said factors particularly pressure and amount of ink used.
3. **Shape of pores:** In the present study the Pores of different shapes have been found to be present (Table-II, Photomicrograph-1-8) on the ridges such as:-
   - Rounded
   - Rectangular
   - Squarish
   - Pentagonal
   - Elliptical or oval
   - Triangular
   - Rhomboid
4. **Position of the pores on the ridge:** In the present study the pores on the ridge may either be situated in the centre or towards the periphery of the ridge. The pores which were lying in the middle of the ridge are named closed pores while those on the periphery were called open pores (Locard, 1912).

Examination and comparison of finger prints with each other, only few ridge characteristics were available in the partial and fragmented fingerprints. In order to compensate
for the short-fall in the number of characteristics required for establishing identity Poroscopy and Edgeoscropy were considered to complete the analysis/comparison of the fingerprints.

All the samples including fragmented inked prints (both with printer’s ink and stamp pad ink) were examined under stereomicroscope (Motic 400 Stereo zoom Binocular), A camera was attached to it to facilitate the recording of the fingerprint images at different magnification. The variations in the pore and edge characteristics of the impressions with printer’s ink on the different types of paper were found to be clearly visible at 40X magnification.

Photomicrographs of all the samples were prepared at 40X magnification and compared for First, Second and Third Level Details (Edges and Pores besides ridge characteristics).

In partial and fragmented fingerprints the first Level details were absent and in such cases second and third level details were studied. The photomicrographs of fragmented fingerprints of 100 individuals have been marked for second and third level details (Appendix-I)

The photomicrographs of complete and only few of the partial finger prints were successfully identified by comparing fingerprint patterns, and 8-12 ridge characteristics present in their correlative positions. But the remaining cases of partial and all the smudged or fragmented fingerprints could not be compared due to lack of fingerprint pattern and sufficient ridge characteristics in their correlative position i.e. First and Second level details. Photomicrographs of these samples were compared with the help of very few second, and the third level details (which include Poroscopy and Edgeoscopy).

The details about the chosen characteristics have been marked in the photomicrographs X1-X24 in both the cases. In these two cases twelve photomicrographs X1-X12 (each case) were compared inter-see as follows:

- Located the same area (present in the fragmented finger print) in all the complete, partial and Fragmented or smudged Finger Prints.
- Then the Second and third level details were marked in their correlative position (Table-III).

After locating the second and third level details in their correlative position, attempt has been made to measure the distances between the third level details to improve the earlier methodology of comparison of fragmented fingerprints (which has very few ridges and limited points of similarity).

The final results were analyzed statistically.
Comparison of Finger Prints

All the photomicrographs of Complete, partial, fragmented or smudged finger prints were examined inter-se for first, second and third level details. In complete and partial finger prints the first level details were present. So all of them were compared with the help of First and Second level details. But in case of fragmentary or smudged finger prints only few ridges were available in all the photomicrographs. Attempt has been made to compare these ridges on the basis of second and third level details.

- **First level** details include patterns, which were not available in all the photomicrographs taken from fragmentary and smudged finger prints.
- **Second level** details include ridge characteristics (Galton Details) a few of them were available in the photomicrographs-9.
- **Third level** details include pores (Poroscopy) and edges of the ridges (Edgeoscopy) which was available in sufficient number for the comparison purposes (photomicrographs-9).

Inter-se comparison was made in all the photomicrographs of the finger prints as follows:
Located the same area (present in the fragmented finger print) in all the complete, partial and Fragmented or smudged Finger Prints. Then the Second and third level details were marked at their correlative position (Table-3).

In all the 12 photomicrographs the 14 points of second and third level details have been in their correlative position.

Hence with the use of the third level characteristics prints with only three ridges with no first level details and only two second level details, a positive identity could be established.

In the Present Study a further attempt has been made to improve the earlier methodology of comparison of fragmented fingerprints (which has very few ridges and limited points of similarity) and the final outcome by measuring the relative distances between the Third level characteristics.

Graphical simulation and analysis techniques have become so advanced that we cannot doubt their accuracy. The third level details including Pores and Edges of the Ridges were again marked using graphical software (Photomicrograph X13-X24) and these markings were objectively analysed by measuring their relative distances. The other third level details including
Angle, Relative distances were measured and the data generated was statistical analyzed. Hypothesis testing procedures were used to substantiate the results and inferences drawn.

The characteristics were measured in the photomicrographs (X13-X24).

**Statistical Interpretation**

The four statistical tests namely one way ANOVA, Levene’s test, Brown-forsythe’s Test, Barlett’s Test were applied to interpret the data and to check its significance. The hypothesis formulation was made that the Null Hypothesis asserts that the variances are identical (that means the photomicrographs are taken from same sample and in the same area) so that the alternative hypothesis will imply that at least one of the variances is different from another (or the photomicrographs are taken from different fingerprints and/or different area of the same fingerprint).

After completing the present study, The following Conclusions were drawn

- Besides the characteristics of the First, second and third level details, another additional dimension have been added to the present study in the form of measuring the distances between the third level characteristics.
- Third Level details are as permanent as finger prints and also persistent.
- More details were observed in the prints taken with Printer ink (Kores and Sirchie) than the stamp pad ink and it provides more points for comparison under identical situations. Prints obtained with Sirchie ink were still better then Kores printers’ ink particularly when third level details required. In some of the prints pattern of the stamp pad net was also observed which affected the clarity of the prints.
- Addition of the characteristics of Edgeoscopy and Poroscopy may finally lead to positive conclusions despite the finger prints having very few ridges with limited number of Ridge characteristics.
- These details can also be applied to the palm prints to determine the authorship of the writer to a certain extent.

All the samples of partial and smudged finger prints provided during a Blind Trial were identified correctly using the Third Level characteristics.