FORENSIC SCIENCE

Forensic science in criminal investigation and trials is mainly concerned with materials and indirectly through materials with men, places and time. Among men, the investigating officer is the most important person. In fact, it is he whose work determines the success or failure of the application of forensic science in the processing of a criminal case. If he fails to collect the relevant correct evidence, allows them to be contaminated or does not provide correct samples for comparisons, the findings of a forensic scientist will be useless; nay, they will be helpful to the culprit.

Material are identified and compared with the processes of forensic science. They establish the presence or absence of a link between the crime, the criminal, the victim, the place and the time of occurrence. The important materials, therefore, form the various chapters of the book. In addition, the place of occurrence being the most important source of materials has also been discussed.

1.1 NATURE

Forensic science embraces all branches of science and applies to the purposes of law. Originally all the techniques were borrowed from various scientific disciplines like chemistry, medicines, surgery, biology, photography, physics and mathematics. But in the past few years it has developed not only its own techniques but also its own branches, which are more or less exclusive domains of forensic science. The science of fingerprints, anthropometry, track marks, documents (especially the examination of handwriting) and forensic ballistics essentially belongs to forensic science alone. More recently significant advances have been made in serology, voice analysis, odour analysis, and in studies relating to pattern recognition through computers. The most significant development of the twentieth century however had been DNA profiling for identification of human beings. It has been since extended to animals and even to plants.

Two peculiarities characterise Forensic Science:

- It is multi-professional.
- It is multidisciplinary.

The Forensic scientist has to depend upon for proper functioning of the forensic science, on the investigating officer, on the one hand, and on the other, on the presenting counsel and the judge for its effective utilisation in the dissemination of justice. If the investigating officer does not know how to collect the correct clues, how to preserve them, how to pack them and keep intact the integrity and the identity of the clue material, the best of the expertise and the best of instrumentation with the scientists would not help. The investigating officer has to be a specialist in handling the correct clue correctly. Likewise the counsel and the judge have to know the science broadly so that they can co-relate the scientific evidence with the rest of the oral evidence, circumstantial

evidence and evidence of the other specialists. Public has also to know the importance of the science and of the clue materials so that they do not disturb, destroy or contaminate the clues at the scene or elsewhere.

The second peculiarity is that the science is an all-inclusive science. Nay, over the years, the science has also developed its own branches (fingerprint identification! handwriting identification!!). Consequently a comprehensive Forensic Science Laboratory has to have experts in all discipline, equipment for all branches and a comprehensive library and the required utilities. It is not possible to do so - too costly. Hence it is not even attempted. The major facilities, which form the bulk of the work of the laboratory, are organised. Assistance for the specialties, which are utilised only rarely, is obtained from institutions where such facilities are available. The laboratories, in fact, are located at such places where other scientific institutions such as universities, medical institutes, institutes of technology or other institutes of higher learning, research and development are available.

1.2 NEED

There is urgent and wide spread need for the application of forensic science in the criminal justice delivery system. The present day scenario of crime investigation and prosecution of criminals, in India is a sad sight. A large percentage of the trials, in heinous crimes ultimately, end in acquittals. The official figure (1998) for the acquittal is 93% whereas unofficial figure is even above 96%. It is estimated that the prosecution agency spends lakhs of rupees on each trial. Thus, not only a dangerous criminal goes scot-free but the huge amount of public money is also wasted. These frequent acquittals also embolden the criminals and escalate crime and multiply criminals.

> *The author once attended a court as witness where one of the accused was facing trial for eleventh murder, of his own father this time. He was acquitted in the previous ten murders. (CH)*

The need for the application of science in the dissemination of justice is pressing. Many factors, including the following are responsible for the same.

1.2.1 Social Changes

The society is undergoing drastic *social changes* at a very rapid pace. India has changes from a colonial subject nation to a democratic republic. Sizeable industrial complex has sprung up. The transport facilities have been revolutionised. There is a growing shift from a rural to an urban society. These changes have made the old techniques of criminal investigation obsolete. In British days the police was so much feared that once it laid its hands upon an individual, he would 'confess' to any crime, he may not have even known. The fear is vanishing now. The use of 'third degree' techniques used in those days (used even today*) does not find favour with the new generation of the

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* The abuse is indicated by the custodial deaths. The National Human Rights Commission received 666 cases of such deaths in six months (from 1-3-2002 to 30-9-2002), averaging 4 custodial deaths daily. Main culprit states are UP (100 cases), Bihar (75 cases), Maharashtra (69 cases), Andhra Pradesh (58 cases) and Punjab (40 cases). *Hindustan Times, 7th October, 2002, Chandigarh Edition.*

administrators, the judges and the public at large. It is true that the third-degree methods are not completely out but their abuse is becoming increasingly hazardous to the perpetrator. Besides, their effectiveness is diminishing at a still faster rate. Other methods have to fill the vacuum.

1.2.2 Anonymity

The quick means of transport and the high density of population in cities have facilitated the escape from punishment after the commission of crime. The criminal can hide himself in a corner of a city or move away to thousands of miles in a few hours after committing a crime at a particular place. Nobody, at the new place, would know or try to know who he is or where he has come from. He, thus, often escapes apprehension and prosecution.

The individual is becoming self-centred. He, especially in cities, does not know even his next door neighbour. Thus even if the neighbours are killed, the murders come to light sometimes only when the bodies putrefy and emit foul smell. In the meanwhile the culprit(s) leave the scene and the evidence is also destroyed, obscured, becomes indistinct or diminished.

1.2.3 Technical Knowledge

The technical knowledge of an average man has increased tremendously in recent years. The criminal is using science. The crime techniques are getting refined. The investigating officer, therefore, needs scientific methods to combat the modern scientific criminal. For example, the night vision appliances were

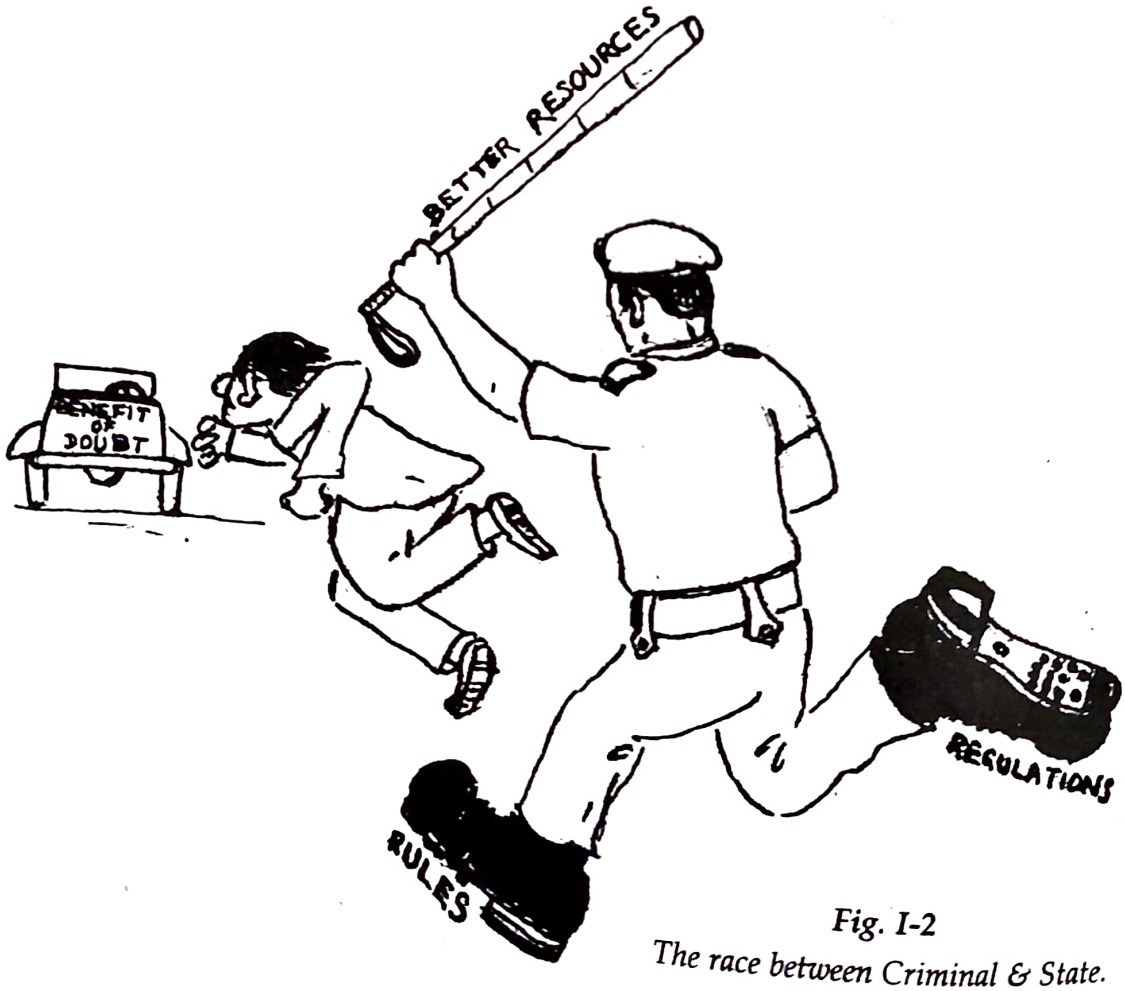

Fig. I-2
The race between Criminal & State.

being used by the terrorists routinely in Punjab. The security forces could meet the challenges only when they also employed night vision devices to fight them.

1.2.4 Wide Field

The field of activities of the criminal is widening at a terrific rate. Formerly, the criminals were usually local, now we find that national or international criminal is a common phenomenon. Smuggling, drug trafficking, financial frauds and forgeries offer fertile and ever expanding fields. International terrorism in recent times has acquired global proportions and the gadgetry often utilised by the terrorist is usually mind-boggling to the common investigator. The recent attack on the World Trade Centre in New York and on the Pentagon in Washington, destroying property worth billions of dollars and killing thousands of persons, in one go, is really more than an eye opener to the world about the capabilities of the terrorist.

Cyber crimes have gone beyond the earth—in the space, though the perpetrators are earthly beings, but they have ultra high sophistication.

1.2.5 Better Evidence

The physical evidence evaluated by an expert is objective. If a fingerprint found at the scene of crime, it can belong to only one person. If this person happens to be the suspect, he must account for its presence at the scene. Likewise, if a bullet is recovered from a dead body, it can be linked to only one firearm. If this firearm happens to be that of the accused, he must account for its involvement in the crime. Such evidence is always verifiable. It is free from human failings.

1.2.6 Alternatives

If we do not adopt scientific method what are the other alternatives and how do they stand in the test of their ultimate utility.

The alternatives to scientific methods which have been in vogue since time immemorial are :

- Eye Witnesses
- Confessions
- Approvers
- Stock Witnesses.

Fig. I-3
Eye-Witnesses not always reliable.

1.3 FUNCTIONS

Forensic science provides answer to the following questions:

1. Has a crime been committed?

Consider the case of the recovery of a dead body. Death could be natural, accidental or it could be homicidal. Forensic science by ascertaining the nature of death establishes the existence or absence of *corpus delicti*. It is true for non-death crimes also.

Fig. I-5

Establishing Corpus Deliciti.

2. How and when was the crime committed?

The examination of the *corpus delicti*, the evidentiary clues and of the scene of crime can possibly indicate the *modus operandi* and the time when it was committed.

3. Who committed the crime?

Forensic science establishes the identity of the culprit through:

- Personal clues like fingerprints, footprints, blood drops, hair and the like.
- Objects left by him at the scene and with the victim or carried from the scene and from the victim.

Forensic evaluations have progressed tremendously in recent times. It has crossed all physical barrier as far as the analyses of the evidentiary clues are concerned. Even the tiniest clue in nanogram and beyond, can be analysed. The science is, therefore, in a position to provide the help practically in all cases.

Further, Forensic Science helps the criminal justice system:

- Provides leads to the investigation.
- Establishes whether the scene is real or fake.
- Locates hidden clues, correct clues, and also proper samples for comparison.
- Establishes sequence of events.

- Verifies the prosecution version, the defence versions and finds the correct version.
- Saves the innocent accused by de-linking him with the clues, with the victim or with the scene of crime.
- Identifies the victim in cases of putrefaction or mutilation of the body.
- Identifies the correct crime weapon.

1.4 DEVELOPMENT

The application of forensic in the investigation of crime can be effective only if the investigating officer knows :

- The nature of physical evidence to be collected.
- Where it is found.
- How it is collected, packed and preserved.
- What standard samples for comparison purposes are necessary.
- How much sample is required.
- How the sampling is done.
- How the evidence will link the crime with the criminal and to what extent his labours will be rewarded by the laboratory results.

This is possible if the investigating officer is given a thorough grounding in the above aspects. He needs both theoretical and practical training.

All police training institutions have courses in scientific aids, but the syllabi and the teaching standards are far from satisfactory. Periodical attachment of investigating officers to the departmental forensic science laboratories can go a long way in inculcating the scientific spirit. This is being done by some of the police forces.

Ignorance about the value of evidence sometimes causes a lot of disappointment to an investigating officer. For example, hair is recovered in some cases. Evaluation of hair does not lead to positive identification of the source of hair. It is not possible at the present stage of development of the science, unless the hair carry roots with the body cells. They would not be disappointed, if they know the limitations.

In addition, the other professionals involved, the lawyers and the judges must also know the applications, the potentialities and the limitations, so that they can utilise the evidence in the dissemination of justice.

The public should also know how to preserve the evidence at the scene or with the victim, so that the authenticity and integrity of the evidence remains intact and the evidence can provide a proper linkage between the criminal and the crime.

1.4.1 Academic Courses

Academic courses in forensic science have come up some universities. Some of them (Bundel Khund, Madras, Punjabi and Sagar Universities) have postgraduate courses. One of them (Sagar University, MP) also runs the graduate course, while some others have diploma/ certificate courses, which are mainly meant for the non-Forensic Scientists, utilising forensic science.

Forensic science has not yet been introduced as one of the subjects taught in science degree courses. It should be done, so that persons with this academic background employed in the departments of law, police, or judiciary will appreciate and apply the science in criminal investigation and trials. It will bring better dispensation of justice.

1.4.2 Research

There are few whole-time researchers in forensic science. This is in spite of the fact that the field is yet unexplored and is very rich in problems. A few research papers, however, do appear in journals. They are mostly by persons engaged in actual laboratory routine. Some interesting facets of a problem may coax the scientist to investigate the problem further. Or, sheer necessity in the examination of a case may compel him to carry out experiments rather on an extensive scale. An average laboratory worker is too heavily burdened with routine to find time for research. Induction of Forensic Science in the Universities augurs well for research. Persons are taking up research for doctoral degrees.

1.4.3 Dissemination

There is a very strong case for proper dissemination of forensic science knowledge among all those who are involved with forensic science including judges, lawyers and the police officers.

Proper dissemination of knowledge on various aspects of forensic science can be achieved only if the modern modes of dissemination like multimedia and internet are utilised, common forums are established where police officers, forensic scientists, lawyers, judges, and even laity can get together and discuss topics of common interest. The print media, conferences, seminars and formation of societies should also be utilised.

1.5 PRINCIPLES

The laws and principles of all the sciences form the bases of forensic science. In addition, it has developed its own principles.

1.5.1 Law of Individuality

Every object, natural or man-made, has an individuality, which is not duplicated in any other object. It is unique. Neither the nature has duplicated itself, nor man can.

This principle, at first sight appears to be contrary to common belief and observations. The grains of sand or common salt, seeds of plants or twins look exactly alike. Likewise man-made objects : coins of the same denomination in the same mint, currency notes printed with the same printing block one after the other(excluding the serial number) and typewriters of the same make, model and batch appear to be indistinguishable. Yet the individuality is always there. It is due to small flaws in the materials, in the arrangement of crystals, imperfect stamping or due to inclusion or exclusion of some extraneous matter or other material.

The individuality has been verified in certain fields. The most extensive work has been carried out in fingerprints. Millions of prints have been checked but no

two fingerprints, even from two fingers of the same persons have been ever found to be identical.

In a series of experiments carried out by the author during the study of superimposition techniques for fingerprints, footprints, foot marks, die marks, and marks obtained from various parts of firearms, it was observed that with the best of efforts exactly alike imprints even from the same finger could not be produced, which could be superimposed perfectly . The fingerprints were taken one after the other, on the same paper, with the same ink and by the same person; yet they failed to give perfect superimposition. Imperfect inking, unequal pressure, slight differences in the texture of the surface of the paper or interference from extraneous matter always introduce some differences. If the same finger failed to give exactly alike prints, it is difficult to imagine that exact duplication can be achieved with any other object.

The law of individuality is of fundamental importance in forensic science. Anything and everything involved in a crime, has individuality. Thus the culprit is unique, his *modus operandi* is unique, his weapon of offence is unique, scene of crime is unique, evidentiary clues, left over or picked up by the culprit, are unique. We have just to identify the uniqueness to link the crime with the criminal.

1.5.2 Principle of Exchange

'Whenever two entities come in contact, there is an exchange of traces mutually'. This is the principle or law of exchange. The French scientist, Edmond Locard, first enunciated it. It is also known as Locard's principle.

According to the principle, when a criminal and/or his instruments of crime come in contact with the victim or the objects surrounding him, they leave traces. Likewise, the criminal and/or his instruments pick up traces from the same contact. Thus, a mutual exchange of traces takes place between the criminal, the victim and the objects involved in the crime. If these left over traces are identified to the original source, *viz.*, the criminal or his instruments or if the picked up traces are linked with the victim, the scene or the objects around the victim at the scene, they establish the contact and pin the crime on to the criminal.

The principle of exchange is amply demonstrated in hit and run cases and in offences against person, tracks and trails (scent, foot and footwear marks and tyre marks). Chance fingerprints, tool marks, dust, paint, soils and professional dust are other manifestations of the same principle. It is difficult to imagine a crime where the criminal, the victim or the objects involved, would not exchange traces.

The basic requirement of the principle is the correct answer to the question 'What are the places or objects with which the criminal or his tool actually came in contact?' If the investigating officer is able to establish the points of contact, he is likely to reap a rich harvest of physical clues.

If a criminal enters the premises through a ventilator, he leaves his footprints in dust on the sill. He also picks up dirt from the place.

If he breaks a window or a door, the jimmy or other instrument used, leaves its marks on the wooden frame. Fragments of paints, wood, glass also gets transferred to the jimmy, to the clothes or person of the culprit.

The burglar, who opens a safe by an explosive, leaves the area around and the clothes (including shoes) covered with insulating material as well as some exploded and some unexploded explosive materials.

The criminal is likely to leave and carry minute traces only. It is seldom that he dares or neglects to leave or carry gross objects or traces. On a thorough search traces connect the crime and the criminal as effectively as the gross objects, perhaps more subtly.

Fig. I-6

The Linkage—"Contact Leaves Traces".

1.5.3 Law of Progressive Change

'Everything changes with the passage of time'.

In other words nothing is permanent–immutable or invariable. The rate of change varies tremendously with different objects.

The impact of the law on forensic science is immense.

The criminals undergo progressive changes. If he is not apprehended in time, he becomes unrecognizable except perhaps through his fingerprints, bone fractures or other characteristics of permanent (comparatively speaking) nature (which are not always available) like body fluids which contain body cells which have unique DNA profile.

The scene of occurrence undergoes rapid changes. The weather, the vegetable growth, and the living beings (especially human-beings) make extensive changes, in comparatively short periods. Longer the delay in examining the scene, greater will be the changes. After some time, the scene may become unrecognizable. For example, a road accident scene on a busy road will lose all evidence if the same is not processed at once.

The objects involved in crime change gradually, the firearm barrels loosen, metal objects rust, the shoes suffer additional wear and tear and the tools acquire new surface patterns. The degree of change depends upon the time, the upkeep and the extent and frequency of use or the misuse of the particular object. In course of time the object may lose all evidence for practical identity *vis-a-vis* a particular crime.

The principle, therefore, demands prompt action in all aspects of criminal investigation.

1.5.4 Principle of Comparison

'Only the likes can be compared.'

It is the principle of comparison. It emphasises the necessity of providing like samples and specimens for comparison with the questioned items :

In a murder case, a bullet is recovered from the deceased. The expert opines that the bullet has been fired from a firearm like a service rifle, firing high velocity projectiles. It is futile to send shotguns, pistols, or revolvers as the possible suspect firearms.

A bunch of hair is recovered from the hands of the deceased. The expert opines that the hair belongs to a Negroid person. Hair from persons of white races for comparison will not be of any use.

The questioned writing is found to have been written with a ball pen. To send fountain pen as likely instrument of writing is futile.

Writings, allegedly written on a wall, made available on a photograph, could not be compared with the specimen written normally on a paper. It did not give worthwhile results. A second set of specimens was obtained. The writing was done on the same wall, at the same height and with the same instrument and then photographed. It allowed comparison. (CH)

A few years ago, an investigating officer sent moulds bearing footwear impressions lifted from the scene of occurrence along with specimen moulds prepared before a magistrate. The sole patterns were different. Further inquiry revealed that the investigating officer had used new pairs of shoes to get the specimens prepared. The investigating officer thought that the culprit could be identified from the pressure patterns from the individual impressions on each mould! (CH)

1.5.5 Principle of Analysis

'The analysis can be no better than the sample analysed'.

Improper sampling and contamination render the best analysis useless. The principle emphasises the necessity of correct sampling and correct packing for effective use of experts.

A criminal while running away from the scene of occurrence brushes against a painted surface. Some powdered particles of paint get deposited upon the clothes. The investigating officer scrapes a few grams of paint from the same surface with a pen-knife and sends it as control sample. The result of the analysis shows that the two paints do not match. Why?

A small amount of dust is recovered from a small sticky patch of the shoe of a culprit. The investigating officer collects about two-kilogram of soil from the scene, packs it in a tin and sends it as control sample. The result of comparison is inconclusive. Why?

In a rape case, the investigating officer collects the clothes of the victim. The clothes carry both blood and semen stains. The investigating officer dries the clothes and packs them together and sends them through a railway parcel. He wants to know if the clothes carry semen stains, and if so, to which blood group does the culprit belong? The semen gave AB group. The culprit had A group. The victim had B group. Why the wrong results?

1.5.6 Law of Probability

All identifications, definite or indefinite, are made, consciously or unconsciously, on the basis of probability.

'Probability' is mostly misunderstood. If we say that according to probability a particular fingerprint has come from the given source, the defence counsels will make most of the word and plead that it is not a definite opinion. Consequently, it is not customary to talk of 'probability' or 'probability figure' in courts.

Probability is a mathematical concept. *'It determines the chances of occurrence of a particular event in a particular way out of a number of ways in which the event can take place or fail to take place with equal facility.'*

If P represents probability, N_s the number of ways in which the event can successfully occur (with equal facility) and N_f the number of ways in which it can fail (with equal facility), The probability of success is given by the formula:

$$P_s = \frac{N_s}{N_s + N_f}$$

If the event consists of two occurrences which can take place *independently*, the probability of the second occurrence is also given by the same formula. If we denote probabilities of the first and second occurrences by the attaching digits 1 and 2 to the relevant letters, the net probability (P_t) is given by the formula:

$$P_t = P_1 \times P_2 = \frac{N_{s_1}}{N_{s_1} + N_{f_1}} \times \frac{N_{s_2}}{N_{s_2} + N_{f_2}}$$

Likewise if the event consists of 'n' independent occurrences, the net probability of the event is given by:

$$P_t = P_1 \times P_2 \times P_3 \ldots P_n$$