



Forensic Entomology: Past, Present and Future

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Entomology is the study of insects, derived from the Greek word entomic (insect) + logos (word, cause). One of the oldest branches of forensic science is forensic entomology. Over time, you can see the time of death, the field of death, the movement or preservation of the place of death, etc. Advances in insect toxicology have expanded and strengthened the role of entomology in forensics. The use of DNA for species identification ushered in a new era for the discipline. These are some of the areas that our future research should focus on.

The Past

Forensic entomology will appear first in Chinese literature. Song Zi, a Chinese lawyer and death investigator, mentioned the first case of insecticide in his book Xi Yuan Zhi Lu, written in the 13th century. In this case, the stabbing took place near a rice field. The day after the accident, investigators asked all workers to throw away their scythes. Insects (perhaps flies) are drawn to one of the infected by the invisible blood.

Therefore, the culprit was arrested and confessed. There are other examples of lines found on corpses in medieval texts. According to records from the 15th and 16th centuries, insects play an important role in the destruction of the human body. They describe a pattern of insect body decomposition and skeletonization that has been copied by modern science. In 1767, zoologist Carl von Linné said that three flies could kill a horse as fast as a lion. Now that we understand the role of entomology in the middle Ages, let's turn to the present.

The French doctor Bergeret is considered the first modern case of forensic entomology. In 1855 he discovered the postmortem range (PMI) using forensic entomology. At that time, the boy's body was found in a house. Bergeret was sent to find PMI. When he found PMI, he thought it took a year for metamorphosis and females lay eggs in the summer so that the larvae develop into pupae the next spring and hatch in the summer.

He found *Musca carnaria* L. eggs in a fleshy stem that spawned before drying. From these observations, it is assumed that the body has been lying there for at least a few years. So even with limited knowledge and resources, entomology can then be very useful. Pierre Mégnin is considered the first person to conduct scientific research in the field of science.

He worked on the subject for nearly two decades, including his results in his book Lafaune des Cadavres, published in 1894. It assumes that there are eight rows of corpses opening up to the book. He also said that the lines appeared in two different tombs. He also described the morphological features of various insect species that helped identify them. His contribution to the popularity of the discipline is unparalleled.

People began to apply Mégnin's conclusions to the plants and animals present in their region, when it became clear that their research required many assumptions. This process started at the beginning of the 19th century and continues to the present day. German doctors Klingelhöffer and Maschka and forensic pathologist Stefan von Horoskiewicz from Poland

(then Austria) demonstrated the relationship between ants and cockroaches in the production of counterfeit products. Horoskiewicz and Maschka described ant or insect bites that looked like scratches or bruises from life. In all these cases, innocent people will be prosecuted without the conclusions and testimonies of respected experts.

France and Germany were the main centers of entomological research at that time (at the beginning of the twentieth century). This can be seen in two novels from that period: Alfred Brehm's *Thierleben (Animal Life)* and Jean Henri Fabre's *Souvenirs entomologiques (Ten Lives)*.

Focusing on scavengers and flies, these books helped popularize entomology with the general public. Over the next few years, many researchers have been working on the subject, and the data on good bugs continues. While research on the topic has increased, the popularity of the topic has not. Only a few scientists in the world have studied insects. The main purpose of this research is to create information specific to the area and its environment. Everything changed in the mid-1960s. Even Watson and Crick, who discovered DNA in 1953, did not expect it to be used in scientific research, particularly in forensic entomology.

The use of DNA in the identification of anomalies in the new era. DNA has long been used to identify traces found at crime scenes. This method is reported to be more professional and scientific than morphological characterization.

We will not discuss the pros and cons of using DNA for identification; instead, we point out that the use of DNA is an unreliable step in that direction, given the diversity of species and diversity in animals. Insect toxicology emerged as a new discipline in forensic entomology in the late 1970s. Toxins were found in invertebrate decomposers in this study and were used to determine cause of death. Therefore, forensic entomology is evolving from simply detecting PMI to determining the cause of death.

The Present

In the 1970s, it evolved from metal analysis to find many products and their metabolites. Beyer et al. (1980) described a case where a woman was found to be in the early stages of skeletalization 14 days after death. They used gas chromatography (GC) and thin layer chromatography (TLC) to detect the bacterium *Cochliomyia macellaria* (Fabricius) (Calliphoridae); results confirmed the presence of phenobarbital. Since then, many researchers have discovered benzodiazepines, barbiturates, tricyclic antidepressants, various opioids, and other drugs (the list goes on). The extraction method is also available from GC and TLC to RIA, MS, HPLC, etc. turned into various methods such as

All this indicates that all chemicals can now be recognized at the minute level in adults and larvae. Although the practice of insect toxicology has grown and opened new doors, it still has many issues that need to be addressed before it can be used as a forensic tool. We do not currently know the drug prescribed by the insect. We also forget about the level of concentration of various drugs. Many chemicals have been shown to affect the growth rate of insects.

Some drugs increase the rate of growth, while others slow it down. Ignoring this fact can lead to errors in the PMI estimation of up to 18 hours, and in some cases more. Let us now turn our attention to the more practical use of forensic entomology that PMI has discovered. At the same time, the flora and fauna of different ecoregions around the world have also changed. This also applies to insects.

Therefore, research is currently monitoring these changes and updating our expertise. As mentioned earlier, invertebrates are the most abundant species on earth. We are far from knowing everything we know about each species. This is especially true in tropical countries like India. Therefore, new research should be increased to find more species in the world.

This is one of the most important events occurring worldwide. The use of DNA for species identification and classification is becoming increasingly popular. The benefits of this concept are obvious and need no further explanation. Part of the practice of forensic entomology, child abuse and sexual abuse, can be hard to believe and even harder to detect. Data presented by Benecke and Lessig (2001) show its application to child abuse.

They cited a case where the boy's body was found. Estimated time to death using forensic entomology is 6-8 days. However, the scars found in the child's anogenital area showed that it had not cleared in the 14 days before the child died. This case marks a turning point in the application of entomology to the study of child abuse. Studies have shown that postmortem organisms, particularly maggots, combined with natural changes, can make clothing similar to those reported to be sexual assault (Komar and Beattie, 1998).

This is even more important in cases where segregation has already begun. Forensic entomology is not limited to detecting PMI. Forensic entomologists play an important role in the death investigation. It has to perform many tasks, in particular, the number of days since death, the season of death, the place of death, the transportation or storage of remains after death, the time of beheading and/or dismemberment, intervals of submersion. Physical injuries, corpses and crimes Post-mortem artifacts at the crime scene, drug use, tethering the suspect to the crime scene, child neglect, sexual abuse and who the suspect is.

The Future

The first and most important step is to identify the right animal. Even now, we don't know every kind of error. Therefore, completing our list should be our priority. Species identification methods, from morphological features to DNA analysis, may vary, but the fundamentals cannot. After identifying the animals, the next step is to identify the animals in different places.

For this, research should be carried out in the specific area where the animals are located. Animals only depend on the time of day, season, etc. not only by region, but also by region. Therefore, all these aspects should be taken into account when conducting research on the subject. I would like to give a few examples to clarify our subject. First, the body was found in the car.

The car can now be considered a unique ecosystem because it has few, if any, entry points. So we don't know which species will be able to access this separate address and when. Another example is insects that live in lakes, rivers, oceans and other bodies of water. This is important in cases where there is still water. It is very difficult to determine the time of death because in most cases the body has degenerated beyond recognition.

Therefore, entomologists can help when all else fails. The issue of insect toxicology will be discussed later. Despite the great progress in recent years, there is still much work to be done.

As we mentioned at the end of, science is not yet developed enough to be used in everyday life. Insect toxicology can also be used for identification.

This can be done by extracting DNA from dead bodies. Insects suck on human brains when they feed on human remains. These cells can provide the necessary samples for testing. Although it could be argued that if DNA is present, it will still be present in human samples.

However, in this case, we can say that we experience cases where the body is completely burned.

We sent a DNA sample to see if there was DNA in the remains and it came back negative. There are maggots on the body. Although we did not send the maggots for DNA analysis, we believe we will get a good response, especially since maggots are only found in tissues. Therefore, we believe this is an area that future research should focus on. To be clear, Dizno et al. (2002) conducted some research on this subject. They used mitochondrial DNA

to link the human DNA found in the blood samples to the DNA found in the bones of the deceased. In this case, the DNA of the deceased can be matched. This could prove that forensic entomology can be used to negatively diagnose dead bodies. If there is one thing we should not forget, it is that the future is in the hands of young people.

Young people only step in when we do a good enough job that they can find a job. It is our responsibility, as are those already on the ground. This is why forensic entomology is not progressing as fast as it could. Therefore, the popularity of the region should be the most important thing for all researchers doing international research. More people entering the field will lead to more progress, which will pave the way for future research.

This will start a loop with one result: the branch will be more popular. Therefore, this should be one of the most important aspects of our future development.

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