

Decomposing Dudes and Morphing Maggots

“It sounds like Rice Krispies,” commented Melinda Monsternick.

“They don’t like any kind of light, so when we turn the body over, they squirm away into the ground.”

“You mean soup. The ground looks like a mud puddle. I’ve been a detective for 20 years, but I have never seen decomposition like this.”

The research facility at National Medical Labs on the outskirts of Philadelphia consisted of a warehouse-sized building that served as the crime lab, and the research facility, where different outside environments were created to measure and study the decomposition rates of human bodies that had been donated in the name of science. Some bodies were buried; others were put in the trunk of a car or wrapped in a carpet and placed in a pool of water. As many as 10 bodies could be found decomposing within the facility at any given time.

Dr. Blass tried to explain the process of decomposition and its relation to forensic entomology. “It’s disgusting, but bugs and other fauna are like clocks of death,” he said. “We’re talking about the PMI here, and I don’t mean the thing that happens to women once a month. The post-mortem interval is comprised of several factors. We need to consider the amount of rigor mortis, the color of the body, which is lividity; and of course, the algor mortis, which is the temperature. But you know all of that already, don’t you, Monsternick?”

“Yes, I had a training class recently on time of death and using bugs for identification.”

“Right. That’s been my passion for many years now. I love bugs. My wife would like to say otherwise, but I’m one lucky duck. When I first started this job, I was rearing bugs in my basement. One time, I used gauze around the top of my rearing chamber to let in some air. Bad move. They worked their way through the small openings in the gauze that I thought would never be possible. Of course, the maggots had not finished their post-feeding stage and decided to hide all over my basement. Before you knew it, flies were buzzing all over the house. My wife started swatting them with the newspaper and yelling at me. I assured her it wouldn’t happen again and replaced the newspaper with a small butterfly net. We spent the next week chasing blowflies and flesh flies around the house to pin in my first bug collection. Since then, I’ve kept everything in the shed and away from my wife. I also had to buy a lot of jewelry and flowers to make up for my past discrepancies.”

“I would imagine so,” laughed Melinda. “If you’re not in the business, bless your heart for having a sense of humor and love.”

Dr. Blass was a world-renowned forensic entomologist who was very learned in the area of decomposition and the process of insect infestation. His research has seen bodies placed in streams, car trunks, hanging in branches, in the shade, sun, and every other place imaginable, all in the name of science. He continued explaining how decomposition works.

“The first stage is the fresh stage, or autolysis. After your heart stops beating, your body becomes anaerobic, which means there’s no oxygen present. What is happening is the bacteria in your body that was

once good for you is now detrimental because it breaks down your insides. I mean blood vessels, tissues, organs, and the like. It all becomes food for the bacteria.”

As Dr. Blass was expounding on his grotesque studies, Melinda sat intently munching on a granola bar and sipping hot coffee. She did not mind the inner workings of the rank bacteria that consumed the body, for she had grown up in the Poconos with two brothers who had hunted and fished. It was not uncommon for them to entertain themselves at her expense. One time, they'd left a deer head on the handlebars of her bike. Eventually, her repulsion diminished and she became desensitized. Chuckling to herself, she continued her education on decomposition.

“The bloating stage begins when the stomach begins to rise,” explained the good doctor. “While all of those enzymes are eating away at your insides, they release gases, most as a methane gas. You know, the stuff that farts are made of. Well, as that gas builds up, it causes the body to grow like the fat lady at the circus. Of course, if there are lots of wounds in the body, the bloating might not be apparent because the gas has a place to go. The tissue actually separates from the muscles because of gas pressure. This is also called skin slippage. This works really well if you want to slip off the skin from a hand and fingerprint it. One time, we wanted to see if we could use a bloating pig as a Bunsen burner. We cut a hole in the stomach, and a nice blue flame burned for fifteen minutes. Stinky as hell, but interesting.

“In the middle of the bloating stage is usually when most maggots come to life and start chowing. These guys have a built-in digestion system. They spit out enzymes that will start breaking down food before it is even eaten. Talk about time efficiency. Strength in numbers is their mantra, so they work together as a mass that consumes the body. As they squirm and squish together, the friction against the dead body causes the internal temperature to rise significantly. If maggots are present, you cannot rely on an accurate body temperature.”

Melinda nodded, impressed with his scientific claims. She was kind of bummed because her new sidekick, Fredric Hassloch, was not with her. He had just joined the unit and was in training to become a detective, and

would have found this impromptu lesson helpful. She made a note to herself to remember as much as she could and listened on eagerly.

“Next comes the putrefaction stage,” claimed Dr. Blass. “Tissues begin to liquefy within the body and leak out. These fluids, combined with ammonia from the maggots, seep into the soil, and it becomes alkaline. At this point, none of the normal microscopic inhabitants are happy, so they leave and the others take over their turf. Years after the body has skeletonized, the soil can be tested with a Berlese funnel and the microorganisms will still be there.

“While these harmless little maggots are enjoying their grub, other predators come to feast on the maggots. They might be wasps, ants, bees, and beetles. I have seen a string of ants marching with maggots. It looks like a little white dotted line; truly amazing. I guess they have nutritional value or else the bugs wouldn’t eat them. Other times, the hairy maggot will come and attack other species of maggots. They open the maggot and suck out their insides like Dracula.

“As we near the end of the process, we hit the decay stage. The skin is so badly decomposed, it tears and breaks, allowing the liquid insides to ooze out. You can easily see the maggot masses ravishing the flesh as the skin breaks apart. Maggot masses are most evident because they have found their munching buddies and are working hard. You need a strong stomach for this stage because it smells the worst. Think of rotten eggs, beef, and milk all sitting in a bag in a hundred-degree sun. Open the bag, and you’re pretty close to the smell of decay. Near the end of this stage, some species of beetles will arrive to gnaw the dry skin.

“After the gorging, the maggots leave for a post-feeding stage. They will find safe ground and begin to pupate. This is the final larval stage and when we see them next, they have metamorphosed into adult flies. By the end of the decay stage, only 20 percent of the corpse remains, consisting of skin and bone. When the corpse is reduced to skin, bone, and cartilage, the flies leave the body. The corpse is now beginning the post-decay stage. You will find various species of beetles, like hide and hister, that eat the skin. The soil is also being overrun with microorganisms that continue to feed on decomposing material.

“Now the only thing left is the skeleton. Believe it or not, hunters and fishermen have discovered many bodies in the woods. Do you know why?”

“Yes, I do. My brothers found a body one time while hunting in the woods. Before they decided to tell anyone about it, they made me go with them to check it out. It was a half-exposed human skeleton. We sat there poking the skull with a stick and a few bugs ran out of it. Right then and there I was hooked. I was instantly wondering who the person was, and it made me sad because someone had died. That became my impetus for wanting to become a detective. I wanted to fight crime and keep people from getting killed. I also thought about studying one of the sciences, but decided I didn’t want to work in a lab.”

“It’s amazing how this stuff works like clockwork, detective. I am trying to develop an instrument that can electronically sniff the air and tell me the exact prevailing compounds. It might assist me in determining the PMI within minutes.”

“So what about the maggots?” inquired Melinda “I’d like to know a little more about them. I brought many samples over for you this morning. I packed them in dry ice, too, just like you requested. I hear you can actually get DNA from the crop of the maggot.”

“Yes, you can,” replied Dr. Blass. “The research is still emerging, but the crop, otherwise known as the belly, can glean much information about the body on which it feasts. For instance, we had a body where the person was on cocaine, and the maggots worked faster because of the drug. It works on the converse, too, with other drugs. Let me tell you a little about our friendly rice cakes down there.

“After the female fly eats her share, she produces eggs and usually lays them on an open orifice or area that has been traumatized. This way, when her babies are born, they have instant access to sustenance.

“Maggots fatten up as they continue eating. The weather has a lot to do with how hungry they are. Through our research, we have acquired an exorbitant amount of data on maggot growth. All maggots will shed their skin three times. The outside of the maggot is composed of chitin, which provides a safety net from the environment. If you think about

your nails, they are made of chitin as well. They will not shed into the next instar stage until they can fill the cuticle.

“In the first instar stage, the maggot is the size of a grain of rice. In scientific terms, that equates to approximately 5 millimeters. They will remain in this stage anywhere from a half a day to one and a half days. Remember, it all depends on weather conditions.

“The second stage of the instar can last anywhere from less than half a day to over three days. At this point, they are hanging with their homies, so to speak, as they dine on their smorgasbord. This is also when the body temperature can reach higher temperatures, like I said before. You will also see maggots with two dots at one end. This is where they breathe. In the scientific world and court, we call them posterior spiracles, but here at the facility, we call them butt breathers. The maggot has also doubled in size and will go almost a day before reaching the third and final stage.”

“You mean they breathe through their butt?” inquired Melinda.

“Yes, they do,” answered Dr. Blass. “If you had your face buried in a slab of beef, you would have to breathe through your butt, too, for continual nourishment.”

She agreed, thinking about when her brothers would pinch her nose shut when she was sleeping. Bizarre entertainment, but for teenage boys, it was customary. Dr. Blass picked up one of the maggots on the end of his pen knife.

“This guy here is in his last stage before entering the post-feeding portion of his life. As you can see, he has tripled in size, and you really have a nice view of the crop. The ridges of the cuticle are easily seen and he now has four spiracles to breathe. This might last anywhere from one to five days. After his pie hole is stuffed to the hilt, he wanders off to find a cozy resting place to digest and get some rest and relaxation.”

“Doc, how many bodies have you studied over the years? I find these averages of fly development staggering.”

“That’s putting it lightly, kiddo,” said Dr. Blass. “The body we are looking at here is guest number 832 at the facility. The data we have collected over the years is insurmountable. God bless the computer. Anyway, let me finish my enlightening lecture.

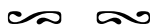
“Maggots seek shelter away from distractions on the ground surface, so they usually go under rocks, leaves, or logs to transform. It pupates to a tiny brown oblong object, like the pigskin used on Sunday afternoons in the fall. The inside of the maggot goes through a metamorphosis where it turns into a fly. When it pops out of its casing, it is very light in color, almost beige. Within a few hours, the fly gets a tan and turns into its normal color depending on the species.

“The whole process ranges from 10 days to a month. The cycle repeats itself until there is no more flesh to eat. Then it has to seek out other manna for nourishment. Long live the fly!

“We did an experiment once to see how far away the flies could smell death. We had some blowflies that we marked with some orange paint. After we walked approximately a mile from the farm, we released the flies and laid out a fresh corpse that was donated to us by a lovely gentleman who wished to continue his name in science. Within two hours of the release, they were at the body eating and laying eggs. The other flies were a little apprehensive about the orange dots on them, but everyone got along for once. It was a great experiment. I published that one in the *Journal of Forensic Science*. I could go on for hours, but I bet you have other things to do, Detective.”

“Yes, I do, but I love listening to this. I’m hoping your research will help us break this case. The body we found is still at the morgue. There was an odious smell infiltrating the woods when we arrived. We are waiting for the DNA results to come back to get a possible ID. We’re hoping it might match the missing kid we’ve been looking for. Once we get further into our investigation, I’ll be in touch. If we can show the time of death within a few hours, maybe we can find a perp without an alibi for that time period.”

Melinda Monsternick finished her morning coffee, thanked the doctor, and went on her way. She had to pick up some cat litter for big Will and then head over to Fredric’s house for his lesson of the day; you guessed it, decomposition. Since he was the new guy she called him Hassie, which was short for his last name, Hassloch. She planned on giving him some homework and sending him to the library to do research to help their case.



Vocabulary

Autolysis Also called the fresh stage, the beginning stage of decay, marked by the breakdown of blood and tissue inside the body.

Bloating The second stage in decomposition, marked by the release of gases in the body, which causes it to rise and appear bloated.

Decay and putrefaction The third stage in the decomposition process, marked by changes in the outward appearance of the body. It is also the stinkiest because of the release of gases.

DNA Deoxyribonucleic acid.

Entomology The study of insects, their life cycles, and their habits.

Instar One of the three stages a maggot goes through during development.

Lividity The changing color of the outward appearance of the body as it enters different stages of decomposition.

Maggot Newly hatched larvae of an insect.

PMI (post-mortem interval) The amount of time that has passed since the death and the discovery of the body.

Rigor mortis After death, the stiffening of joints, muscles, and tissues in the body. It can last anywhere from 12 to 36 hours.

Skeletal stage The final stage of decomposition, marked by bone that has been stripped of tissue, muscle, and organs.

Background Information

Although gross, bugs can tell us a lot about the time of death. Entomologists are becoming more valuable in the forensic world. Research is underway to acquire DNA samples from the crop or belly of a maggot. Insects and fauna represent different stages of decomposition and therefore can help entomologists determine the approximate time of death.

PMI (post-mortem interval) is determined through body temperature, lividity, and rigor mortis. Lividity comes from the Latin word meaning “color of death.” The body changes color as decomposition progresses.

There are other factors affecting PMI as well, such as ambient air temperature, drugs in the body, or different environments (water, wrapped in something, buried, etc.). Rigor mortis comes from the Latin term for “stiffness of death.” When the body stops pumping blood, proteins known as actin and myosin form strong bridges that cause the muscles to stiffen. Rigor mortis usually lasts from 12 to 36 hours. This also helps determine the approximate time of death. Another strong indicator of PMI is the type of insects present on and around the corpse. These bugs can be collected, reared, and identified.

Stages of Decomposition

The first stage is the *fresh stage* or *autolysis*. It starts at the moment of death and ends when bloating is evident. The corpse does not change much on its outward appearance. This is when the inside of the body begins its changes. Tissues break down along with blood vessels. Bacteria begin to spread through the body, releasing enzymes that consume the tissue.

Next comes the *bloating stage*, which begins when the stomach begins to rise. At this point, putrefaction becomes apparent. The enzymes break down and digest tissue and organs within the body. The by-product of the metabolic activity of the enzymes release gases in the form of methane. As the methane increases, the body begins to swell like a balloon. The methane, along with other gases, creates the sweet-sickly smell of death that is found around decomposing material.

During the bloated stage, fluids seep from the body. These fluids, combined with the ammonia from the maggots, seep into the soil, and it becomes alkaline. This is when the normal inhabitants of the soil move out and the microscopic mites move in to feed. They can remain there for years after the body has decayed.

The third stage of *decay and putrefaction* is also marked by a physical change. This begins when the skin is broken and gases are released from the body. Large masses of maggots are highly noticeable in the early

to middle stage of decay. The corpse is still moist and large amounts of fluids are seeping into the soil. This is also when the corpse emits the foulest odor. In the latter portion of this stage, the amount of beetle activity increases. At this point, the maggots leave for a post-feeding stage. They will find safe ground and begin to pupate into their final larval stage. When seen next, they will have metamorphosed into adult flies. By the end of the decay stage, only 20 percent of the corpse remains, consisting of skin and bone. When the corpse is reduced to skin, bone, and cartilage, the flies leave the body.

The corpse now begins the *post-decay stage*. This is when hide beetles come in to feed on the skin. Rove and hisiter beetles accompany the hide beetle to feed, along with other insects.

If the area is wet, the beetles may not appear. They need dried skin to eat. Maggots will also stay on the corpse if it is wet. By the end of the post-decay stage, only 10 percent of the corpse is left.

The final stage is the *skeletal stage*. The corpse is reduced to bones and hair. If left out in the sun, the bones will be bleached white. The only activity left is in the soil. These microscopic organisms can be extracted using a Berlese funnel. A sample is placed in a funnel and a 60-watt or higher bulb is placed over it. A beaker with preservation liquid is placed in a beaker at the bottom of the funnel. As the microorganisms migrate to the bottom of the funnel and away from the light, they fall out into the solution, where they can be viewed under a microscope and identified.

Decomposition is dependent on many factors related to the environment. Bodies have been preserved for thousands of years, such as the Iceman found in Europe. However, in the right conditions, a 150-pound body can be reduced to a skeleton in two weeks.

Fly Development

After the fly has eaten her share of flesh, she will oviposit her eggs on a corpse. Most likely, it will be in an area that is an open orifice or an area that has exposed flesh due to some sort of injury or trauma.



Laying eggs.



Maggot mass.

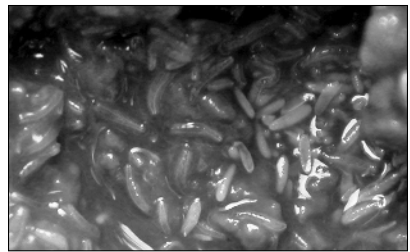
The greatest numbers of fly eggs occur in the early to middle portions of the bloating stage. The maggots release an enzyme that predigests the food, allowing for easy ingestion. With the enzymes breaking down the tissue, a semiliquid is created before it is consumed by the maggot. The maggots will work together and create a mass that moves throughout the body and ravishes it.

The metabolic changes from the maggots and the anaerobic bacteria may cause the body's internal temperature to rise. It has been recorded as high as 127 degrees.

As the maggots grow, other insects are attracted to the corpse. Bees, wasps, hornets, ants, beetles, and other types of flies come to feed on the maggots and eggs.

Maggots develop in size as they eat. Their eating cycle is dependent on the ambient air temperature and weather conditions. They will go through three instar stages. The external cuticle is composed of chitin. It is flexible and provides protection from the environment. It does limit their size, so it cannot molt to the next instar stage until it grows large enough to fill the cuticle.

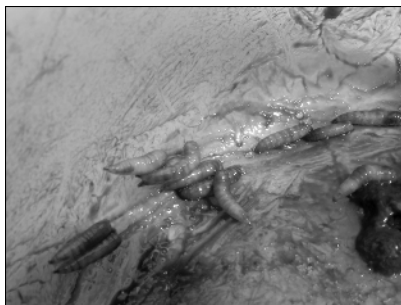
The first instar usually takes the least amount of time. Most maggots complete this stage in 11 to 38 hours, with most developing between 22 to 28 hours. At this



First instar.



Second instar.



Third instar.

time, the maggot is approximately 5 millimeters in length—about the size of a grain of rice.

The second instar stage runs from 8 to 54 hours. Maggots develop a maggot “mass” that continually devours flesh. Maggots need to breathe while eating, so they develop posterior or anal spiracles. Two posterior spiracles are present, and at this stage they are approximately 10 millimeters in length. Most species will go 11 to 22 hours before molting into the third stage.

The third stage lasts the longest. It is divided into two parts. In the first part, there is continual feeding on the corpse. This can last anywhere from 20 to 96 hours. Maggots have four developed posterior spiracles, and at this point, are approximately 17 millimeters in length. When it cannot eat anymore, it enters the second part, which is the post-feeding or wandering stage. This stage can last from 40 to 504 hours, but the average time is 80 to 112 hours. During this time, the stomach of the maggot begins to empty and it starts the pupating stage.

Maggots move to a drier area where they will not be disturbed to finish the metamorphosis. When they do begin to pupate, the color of the pupa is white to yellow. Over the next few hours, the maggot will turn deep reddish brown. At this point, the casing looks like a football.

It is resistant to heat, cold, and flooding. While in the case, the larva changes into an adult fly. The tissues and structures of the maggot are dissolved by a process called histolysis. New structures begin to develop

such as legs, eyes, and wings. This stage can take 4 to 18 days, but most will last 4 to 16 days.

Now the fly is ready to emerge through a round seam at the top of the case that the fly will pop off. The new fly does not look like an adult fly because it is light in color and soft while the wings are wrinkled and collapsed. Over a period of hours, the cuticle hardens and assumes its normal color. Fly development from beginning to end can take from 10 to 27 days at a temperature of 80 degrees. Their adult lifespan will last from 17 to 39 days, and they can reproduce 5 to 18 days after emerging.

Forensic Implications and Jurisprudence

When maggots or other insects are present at a crime scene, many samples are taken. Some are sent to the lab to be reared, while others are preserved to show the developmental stage at the time of discovery. The insects that are kept alive are raised to adulthood and allowed to reproduce. They are placed in vials with small pieces of beef liver for sustenance. When the maggots in the lab reach the same stage as the ones found at the crime scene, they are compared for time estimations. In order for successful results, the scientist should simulate exact conditions in which the samples were found. Since the surrounding climate is one of the most important factors to growth development, it is vital these conditions be recreated.

After identification has been made, the entomologist will try to determine what kind of species of insect it is. Blowflies and houseflies are usually the first ones to arrive, while flesh flies come later when the flesh is exposed, for the flesh fly lays live maggots instead of eggs. There are a considerable variety of flies on this earth, and only a specialist can make the identification.

The court will determine the qualification of an expert and has the right to accept or dismiss a person as an “expert.” While in court, the entomologist can testify only about information dealing with insects, the

rearing process, and the results of that particular experiment. If pictures are required to elaborate on the process of identification, it may be done with permission of the court. Most pictures of decomposition and insect infestation are horrific, if not traumatizing to the victim's family, so the court must be considerate in their decision.

A qualified entomologist must possess a degree in one of the sciences with extensive training and background in entomology. It is also recommended that he or she participate in numerous experiments and have published material on the subject.