

## The Brains of Hammer

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This article is about the Hammer Studios' Frankenstein films:

Curse of Frankenstein (1957)  
Revenge of Frankenstein (1958)  
Evil of Frankenstein (1964)  
Frankenstein Created Woman (1967)  
Frankenstein Must Be Destroyed (1969)  
Horror of Frankenstein (1970)  
Frankenstein and the Monster from Hell (1974)

### A No-Brainer

The Frankenstein films produced by Hammer Studios between 1957 and 1974, a 17 year period, are distinguished from others not only by their garish use of color but also showing actual medical procedures that the 1930s and 1940s censors would not have allowed. In particular, the fascination with brain transplants continues unabated with the Hammer films and in their Frankenstein film cannon, seven films total, we see several brains and this article will dissect each brain to learn what we can learn.

### Brain anatomy 101

There is much mystique surrounding our brains. All humans have brains (even politicians) but some seem to have more brains than others. For some background information please see the article, "Brains, Craniums, and Heads, Oh My!", elsewhere.

The human nervous system is composed of two main components, the central and peripheral nervous systems. The central system contains the brain and spinal cord. From the spinal cord extend the nerves of the central nervous system. Nerves of the peripheral nervous system include sensory and motor functions (muscle movements). Sensory nerves in our skin can detect temperature differences and cuts in the skin as well as hearing, smell, and taste sensations.

Sensory input from the peripheral nerves goes to the spinal cord and then to the brain for integration and processing. The brain can then send signals back through the cranial nerves or the spinal cord stimulating muscle movement (a motor response). All this happens in microseconds.

Another element of the peripheral nervous system is the autonomic nervous system, an involuntary response (not under conscious control), that includes blood pressure control, breathing, digestion, regulating heart rate, perspiration and swallowing.

Our brains are a mere three pounds in weight and though composed of several major areas (see Figure) the brain itself is divided into three compartments, the cerebellum, the cerebrum, and the brainstem. The cerebrum is composed of the cerebral cortex, the bulk of the brain. There is the right and left cerebral hemispheres that communicate through the corpus callosum. Each one of these hemispheres have lobes that specialize in hearing, speech, and vision. The cerebellum is smaller and primarily involved in motor control such as fine movements with fingertips. The brainstem connects the cerebellum and cerebrum with the spinal cord.

The brains of the outfit

The bulk of the brain, the neocortex and what most think of as the actual brain, is composed of four lobes, the frontal lobe (the front), the parietal lobe (the middle), the occipital lobe (back), and the temporal lobes (the sides). The frontal lobe is where planning, language, and speech expression occur. Taste and touch are controlled in the parietal lobe and the occipital lobe controls vision. Language and reception are controlled by the temporal lobes. Right and left-handedness does play a role in brain development as well as whether one is right brain dominated (artistic) or left brain dominated (analytical). (So you gentle readers know, for yours truly, my left brain isn't right and my right brain has left!) Perception of sensations, learning, reasoning and memory are controlled by the cerebral cortex, the wrinkled outer layer of the front parts of the brain.

Another major area of the brain is the cerebellum (underneath the occipital lobe) and this coordinates the movement of muscles. The diencephalon is composed of the thalamus (the cerebral cortex relay center) and the hypothalamus (controls the autonomic nervous system and serves as an overall integration center). Buried in the cerebellum is the epithalamus, more commonly known as the pineal gland or the "third eye", and this controls the body's various rhythms (the pineal gland is used as a key plot point in the film, *The Leech Woman*). The limbic system is composed of the olfactory (smell), amygdala (regulates heart beat), and the hippocampus (controls memories). Lastly is the brain stem which is composed of the mid brain (controls body posture, blood pressure, body temperature, and regulates appetite), the pons (controls respiration, chewing, and taste), and the medulla. The life-sustaining control center, the medulla, controls the heart, respiratory, cough/gag/swallow reflexes, and digestion. Originating from the brain and brain stem are the 12 cranial nerves that coordinate the entire body. Most of these 12 cranial nerves come from the brain stem which is the body's main highway connecting all of the body's nerves and spinal cord with the brain.

## Cranial nerves

There are two sets of the 12 cranial nerves, one for the left side and the other for the right side of the body so 24 total. These 12 cranial nerves, part of the central nervous system, emerge directly from the brain, are paired, and are present on both sides of the brain, unlike the spinal nerves which emerge from the spinal cord. From the brain the nerves leave the skull to integrate with the rest of the body. Ten of these nerves originate in the brainstem whereas the olfactory and optic nerves originate from the cerebrum or forebrain. Stating the obvious, all 12 of these nerves need to be correctly attached for proper brain functions. Should any one or combination of them fail attachment then physical problems will result.

The 12 cranial nerves in order are:

- I. Olfactory (smell)
- II. Optic (vision)
- III. Oculomotor (eye movement)
- IV. Trochlear (eye movement)
- V. Trigeminal (chewing, sensations to skin and face)
- VI. Abducens (eye movement)
- VII. Facial (face expressions)
- VIII. Vestibulocochlear (hearing and balance)
- IX. Glossopharyngeal (taste and salivation)
- X. Vagus (blood pressure, heart rate)
- XI. Accessory (shoulder elevation, head turning)
- XII. Hypoglossal (tongue movement)

There are many nemonics for these 12 nerves and one of the most popular is, "On Old Olympic Towering Towers A Fin And German View, Ah Heaven".

## What can go wrong will go wrong

The brain is a delicate complex organ and it does not take much to disrupt normal functions. With either slight or significant alterations to the brain then many normal body functions can be affected. Trauma, either biological or physical, to any anatomic region of the brain or peripheral nervous system can result in homeostatic imbalance. It doesn't really take much to significantly alter behavior and function in our favorite monsters. Just a little "oops" from our annoyed scientists (or enraged villagers) can dramatically change the course of events. And I am quite sure that many of the 'problems' our favorite monsters have can be easily traced to some sort of trauma from somewhere in or on their brain.

In the various Hammer Frankenstein films we see several brains during the films and some are handled different than others. Though this is primarily due to script changes (and the special effects department) this is not particularly surprising given how complex brains are. With this complexity of delicate tissues then what does it mean when some things go wrong? Some of this is described in the Table.

## Brain damage

If there is damage to the frontal lobe then there could be memory defects, poor concentration, behavioral disorders, depression, and other psychotic disorders. If the parietal lobe is damaged then the monster will suffer motor issues (difficulty using coordinated muscles), have time and speed disorders, have inability to properly read, draw, and write (so you know, the left parietal lobe contains Broca's speech area). Those with occipital lobe damage will have a difficulty receiving visual input and ability to interpret visual images (problems with sight). Those with damage to the temporal lobe will suffer from hearing loss, visual memory, are easily agitated, are irritable, and have short attention spans. Those with cerebellum damage suffer from improper muscle coordination, have a difficulty with balance (walking), swallowing, talking, and eye-hand coordination. Those with thalamus damage have altered consciousness and perceptual losses and those with hypothalamus damage have hormone imbalances and the inability to control body temperatures. Epithalamus problems result in hypertension, epilepsy, and depression. Damage to the limbic system can result in loss of smell (olfactory), loss of emotional control (amygdala), sleep problems, loss of appetite, and memory (hippocampus). Those with damage to the brain stem suffer from a loss of consciousness (mid brain damage), can be in a semi-coma (pons damage), or can be comatose with abnormal breathing (medulla damage).

Table: Brain function and damage

Area of brain	Function	Result of damage
Frontal lobe	Planning, language, speech	Memory loss, poor concentration, behavior disorders, depression
Parietal lobe (contain Broca's brain area)	Taste, touch	Lack of muscle coordination, inability to properly read, draw, and write
Occipital lobe	vision	Visual input problems, difficulty interpreting images, problems with sight
Temporal lobe	Language, hearing	Hearing loss, easily agitated and irritated, short attention span
Cerebral cortex	Sensations, learning, reasoning, memory	Loss of memory and lack of reason
Cerebellum	Muscle movement	Lack of muscle coordination, difficulty walking, and talking, eye-to-hand coordination
Diencephalon	Autonomic nervous system	Altered heart rate, digestion, breathing, and urination
Epithalamus (pineal gland)	Body rhythms	Altered consciousness, perceptual loss, hormone imbalances, hypertension, depression
Limbic system	Smell, heart beat, memories	Loss of smell, sleep problems, memory loss

Brain stem	Body posture, blood pressure, body temperature, appetite, respiration, chewing, taste	Loss of consciousness, comatose
Medulla	Heart, respiration, cough/gag/swallow, reflexes, digestion	Comatose with abnormal breathing
Thalamus	Cerebral cortex relay center	Altered consciousness and perceptual losses
Hypothalamus	Controls autonomic nervous system	Hormone imbalances, inability to control body temperatures
Amygdala	Hormonal control	Loss of emotional control
Hippocampus	Sleep, appetite, memory	Sleep problems, loss of appetite, and memory
Pons	consciousness	Semi coma, comatose

### Formaldehyde preserved brains

In the real world all tissues meant to be preserved, including brain tissues, are preserved in formaldehyde (no relation to Mr. Hyde), a naturally occurring organic liquid with a simple formula,  $\text{CH}_2\text{O}$ . It is the simplest of all aldehydes and is similar to formic acid, the major poison of ants. Though formaldehyde is uniformly used as a tissue fixative – it permanently fixes tissues by cross-linking amino acids in proteins - it is at times unreliable since water affects its distribution in tissues. Some areas of brain tissue contain more water than others so some areas would be more 'fixed' than others which could affect some localized brain functions. Typically, a 4% solution of formaldehyde is used to fix tissue specimens. Due to the permanent nature of the fixative it should be noted that formaldehyde preserved brains are totally non-functional. Lastly, formaldehyde is also used as an embalming agent to help preserve tissues.

### Head injury and trauma

Most head injury and trauma occurs with the cerebrum and the results depend upon what area(s) and how much was injured. Damage could range from mild impairment to severe dysfunction. Damage to critical control brain functions could result in a quick death. With some severe trauma cases the person may suffer life-changing and debilitating problems and have behavioral, cognitive, and physical disabilities. In some cases it may take weeks or months to fully recover and some damage may be permanent.

### Epidural hematoma

Epidural hematomas occur when there is bleeding between the outer membrane covering the brain and the skull usually the result of some sort of trauma. Some bleeding can be severe enough that there may be a loss of consciousness, even death if not treated. Bleeding puts pressure on the brain. Other symptoms of epidural hematomas include confusion, headaches, seizures, and vomiting.

### Bullet to the brain

In the film, *Curse of Frankenstein*, the monster is shot in the head. Does a gun shot to the head mean instant death? What a bullet does to a brain depends upon the caliber of the bullet and where it enters the brain. In cases where there is minimal damage but a still functional brain then just repair surgery is necessary. If the brain is beyond repair and the body is still needed then a new brain must be transplanted, something our Baron excels at.

Congresswoman Gabrielle Giffords and the brain trauma she suffered with a bullet through the head is a current example of how other areas of the brain can take over functions and relearn actions. Brains have “neuroplasticity”, meaning the ability to reorganize itself after trauma. When the brain adapts to changes caused by trauma there is a “cognitive reserve” that allows the brain to maintain its function. And this is a key point to emphasize, especially in the Hammer Frankenstein films. Our brains have multiple redundancies that take over when one area is no longer functioning as it should. When this does occur it often takes long periods of rehabilitation for new areas of the brain to relearn simple tasks. And this should also give you a bit of an understanding that when things go wrong, or the wrong brain function takes over, then mental disorders can result, some worse than others.

If a bullet to the brain hits a critical area then, simply stated, game over. However, should the bullet still strike the brain but miss a critical portion then some trauma will occur though there will be little if any pain since there are no pain receptors within brain tissues. Also important are the velocity (speed) of the bullet and whether and where it exits the brain (there is more damage if the bullet stays in the brain). The higher the velocity, such as from a rifle, the more damage caused. If a bullet passes through both the right and left hemispheres of the brain then the damage most likely will be severe. An injury to one side, such as what happens to the monster in *Curse of Frankenstein* (and Congresswoman Giffords), is better than an injury to both sides. The real problem here is in cerebral bleeding (hemorrhage) which can cause an increase of pressure in the skull causing mild to severe headaches and possibly a coma.

To minimize trauma it is best if the bullet misses the brain stem and thalamus which are critical for consciousness, breathing, and heartbeat. Also, best if the bullet misses any major blood vessels (so oxygen can still be delivered to delicate brain tissues). Should the bullet hit the left side of the brain then language and speech will be affected. In addition, best if the bullet misses the cavities in the center of the brain – filled with cerebrospinal fluid – and if struck may lead to excessive bleeding and fill these cavities, which could be life threatening. Lastly, the bullet may be contaminated with bacteria which can infect the wound so this must also be taken care of.

A skull of jello

The brain is like jello in a jar and once inflamed a swelled brain has no where to go so this can lead to more damage. A swelled brain has increased pressure

against the skull which may prevent blood flow that can further complicate brain trauma. Brain swelling usually peaks on the third day after trauma. In some severe cases of brain swelling the skull is cut open to alleviate the pressure. If intracranial pressure (pressure inside the skull) is too high then a coma could be prolonged and ultimately death. An inflamed brain affects all five senses of hearing, sight, smell, taste, and touch. Also to be considered is the brain's ability to perceive and handle pain which is more acute with an inflamed brain.

#### Brain/skull trauma

Skulls offer some protection against some trauma but not all (weak areas are eye sockets, ears and mouths). The brain floats in a thin layer of cerebrospinal fluid within the skull that helps cushion it against trauma. A mild blow to the head can cause a contusion to both the head and brain. Further trauma may result in a concussion and if strong enough can cause a loss of consciousness. All traumatic brain injuries (TBI) are head injuries (though not all head injuries are brain injuries). An impact to the head that disrupts normal brain activity and function is called a TBI. Some TBIs can affect cognitive abilities including learning and thinking skills and can impact health in two major ways: directly that includes unconsciousness, inability to recall the traumatic event, confusion, difficulty learning and remembering new information, trouble speaking coherently, unsteadiness, lack of coordination, and problems with vision or hearing. And indirectly that may take years to develop like dementia and Alzheimer's diseases.

Acquired brain injury occurs at the cellular level and usually means added pressure on the brain such as from a tumor or a stroke. Such injuries are closed head injuries meaning they are confined within the head and frequently cause diffuse brain damage to several areas of the brain.

#### Brain nerve damage

When there is increased intracranial pressure such as from trauma (or a tumor) this presses against nerves, causes nerve compression, and interferes with their function. An increase in intracranial pressure can also affect the optic nerves which may cause the eyeballs to swell (papilloedema). Should increased pressure extend into the cavernous sinus of the brain then the oculomotor, trochlear and abducens nerves can be affected which can lead to double vision. Compression of other cranial nerves can lead to facial pain, hearing loss, and sensory loss. Furthermore, inflammation such as from an infection could affect any of the cranial nerves. Bell's palsy is an inflammation of facial nerve VII (a key feature in the Karlof/Lugosi film, *The Raven*).

When blood vessels that supply the nerves to the brain are occluded or blocked, such as by a clot, then a possible stroke could happen and cause brain damage. This could affect the oculomotor, trochlear, ophthalmic, and abducens nerves.

#### Cranium size

Each of our brains fits snugly in the space provided by our own craniums. And each of our craniums is slightly different from each other in size. Not much but enough. This is important for brain transplants. In these Hammer films it is assumed that the transplanted brain is the exact size, no bigger, no smaller, than the cranium of the monster. Should the transplanted brain be larger than the monster's cranium then size issues become important. How to squeeze this large brain into a smaller space. The opposite is just as problematical. A small brain transplanted into a larger cranium will leave much space for the brain to jostle around that could cause brain trauma and headaches. It should be noted that female brains on average are slightly smaller than male brains. Therefore, male craniums are in general larger than female craniums meaning it would be difficult to fit a male brain into a female skull whereas a female brain in a male skull would be a loose fit.

#### Brain surgery / transplants

A subspeciality that the Baron seems to excel in is brain surgery which includes transplants. There are several procedures for this as seen in the various films. For the most part all of them shown are totally lacking in any sterile technique (not considered a problem during the late 19<sup>th</sup> Century, the time of our FrankenFilms) so contaminations would be rampant.

Among other things, head hair must be removed to maintain sterility. Not only must the scalp be cut through but the skull as well. It would be best to use a scalpel to make a clean cut of the scalp (as seen at the end of *Revenge of Frankenstein* where the Baron has a barely noticeable scar across his forehead suggesting a clean cut made by a sharp instrument and not a crude scar that would be left if using a saw) and use the saw to cut through the skull. Using a saw, as seen in *Frankenstein Must Be Destroyed*, would leave an ungainly scar. Once the skull cap is removed then the brain can be accessed and either removed or replaced with a different brain. Lastly, the skull and scalp would have to be put back for proper healing. The scalp wound healing processes would begin and the cut skull bone would take a few weeks to properly anneal.

#### Intelligence

Do our Hammer monsters show signs of intelligence? What sort of intelligence quotient (IQ) do they have? Mentally, those people with the lowest IQs are classified as cretins then slightly higher are imbeciles, then morons, and idiots, all with IQs under 50. Semi and unskilled workers typically have IQs of between 50 and 100. Those with IQs over 100 are usually considered skilled workers.

If the monster has an IQ below 50 then is he responsible for his actions? Are intellectually challenged humans (those with IQs under 50) responsible for what they do? Same with the monster. Though he may look ugly and come from "made, not born" then does he deserve our scorn and fear? Others with the same IQ though of normal face are not looked upon as monsters so it all comes down to looks and not brains. On the other hand, an intelligent monster would be



looked upon in the same manner. Unfortunately, all are judged by looks over substance.

#### Diseases of the brain

The general hallmarks of humans consist of consciousness, intelligence, learning, reason, and speech. Does the monster have complete cognitive ability in all brain functions? If not, then which ones are lacking, deficient, or misfiring? It is unknown what percentage of the brain needs to function to have a functional Hammer monster.

For the brain transplant does the resulting surgery bring about autism, dementia, perhaps early onset Alzheimers? Is memory affected? Do synapses fire off appropriately? Is vision affected? In most of these Hammer films the monster does not speak so his speech centers (Broca's brain) have seemingly been affected; by trauma or by surgery?

Some diseases of the brain consist of dementia, autism, parkinson's, multiple sclerosis, alzheimers, cerebral palsy, brain edema, memory loss, neuroinflammation (swelling of brain tissues; if severe then could result in a coma), synaptic function, addictions, cognitive disorders, sleep disorder, pain management, spinal cord and spinal fluids. It is unclear which one or combination our Hammer monsters have as a result of their brain surgeries.

#### Diseases of the mind

Though there are many diseases of the mind some of the more common ones are post traumatic stress disorder, panic disorder, fear/anxiety, mood disorders, sleep issues, social cognition, schizophrenia, and manic depression. Our Hammer monsters certainly have many of these issues.

### **The Films**

#### *Curse of Frankenstein (1957)*

Hired helper, Krempe, initially starts as a tutor and develops his relationship with Baron Victor Frankenstein over time. As the Baron states, "In two years I learned all he (Krempe) had to teach...together probing into the unknown, investigating, recording, searching. Always searching." After this Krempe is more of a colleague and lab assistant to the Baron than a tutor.

When discussing the possibility of creating new life Krempe is initially skeptical and thinks it an affront to Nature. Surprised by this comment the Baron says, "You haven't shown any scruples up till now", suggesting Krempe crossed many ethical lines in his years of tutoring and assisting the Baron (some of this is discussed in the article, "Henry and Victor", elsewhere in this volume).

The brain is the last step in creating his monster and the Baron has high standards and comments, "For this (the monster) the brain of a genius will be

used.” Professor Bernstein, “the greatest brain in Europe”, without permission, ‘donates’ his brain to the cause. The Baron pushes Bernstein off a balcony who lands head first onto the tile floor. With a head first fall of about 15 feet there could be considerable brain trauma something never discussed in the film. In the least the skull is probably fractured. Bernstein’s death certificate should probably read, ‘death by head trauma’. After the burial the Baron exhumes Bernstein’s body and removes his brain. The size of the brain shown seems too small (and is, in reality, probably a sheep’s brain). Nevertheless, the Baron places the brain in a liquid-filled glass jar (presumably not formaldehyde and certainly not sterile) which is broken in a struggle with Krempe. As a result glass shards are embedded into brain tissue, mostly in the lobes, which the Baron later removes. It is unknown how much brain damage occurs though some did as a result of these glass shards.

Krempe helps the Baron in the early phases of the monster’s construction but after some soul searching decides the creature should be destroyed. Krempe calls the newly made, not born monster, “a criminal lunatic. It tried to kill you.” The Baron responds, “That’s the brain when you attacked me that was damaged” (in the struggle with Krempe).

For cognitive abilities the monster is able to walk and is fully dressed when seen in the woods (who dressed him, the Baron or himself?), respond to commands, and can reason though unable to talk suggesting some parts of his brain were indeed traumatized.

While in the woods Krempe, using a shotgun some distance away, shoots the monster in the head causing massive brain trauma which kills him. It appears the shot pellets entered the monster’s right eye (right brain hemisphere) with much blood from the wound (this *is* a Hammer film). Though it is not clear, most likely the shot caused a large exit wound at the back of the monster’s head. (If not, then the shot pellets stayed inside the skull causing more damage by ricocheting off the inner skull and bouncing around soft brain tissue.) It is unknown how much dura matter was destroyed as a result of the shot and, of what was left, it is also unknown how much was functional? It is noted that the shot pellets passed through just the right brain hemisphere and not through both which would have been much worse and most likely unable to recover.

If the shot pellets injured a part of the brain involved in motor and sensory functions then this could potentially be repaired (through the use of stem cells and nanotechnology). If the pellets injured enough neurons in the brain then such things as memory, personality traits, and intelligence would be lost forever. In subsequent activities the Baron is blaming any and all mental issues with the monster squarely on Krempe for shooting a ‘good brain’.

Though the Baron revives the monster it is unclear if he uses a new brain (i.e., transplant) or did some repair work on the damaged one; if so, what repair work

was done? The Baron comments to Krempe, "I've started on brain surgery." Not something anyone takes up in their spare time or as a hobby. The top right portion of the scalp of the monster is shaved apparently as a result of this brain surgery suggesting actual repair work and not a brain transplant. It should be noted that not all motor skills are working in sync since the revived monster has erratic body movements and trouble with his gait while trying to walk so there are neuromuscular issues and therefore problems with his cerebellum and parietal lobe. Later, the monster kills a maid but is he mentally responsible for his actions?

### *Revenge of Frankenstein (1958)*

The Baron has outwitted the guillotine, moved to a new community, and has a new name, Dr. Stein. He has set up a nice lab along with his assistant, Karl. The Baron assembles a new body which needs a brain and it is Karl who will be donating his brain for the Baron's new monster. Karl says, "Dr. Stein is welcomed to my brain." Karl has a deformed body, a lame right leg and arm, and wants a new body so he is willing to give up his old one for a new, better body.

With a new assistant, Kleve, the Baron begins the transplant procedures to place Karl's brain into the new, stitched-together body made by the Baron. Upon seeing this body Kleve asks, "Who is he?" Baron responds, "Nobody. He isn't born yet." Kleve responds, "And you made this body from other bodies?" For this 'made, not born' creature the Baron opines, "The brain is life so a living brain must be used." Kleve and the Baron then transplant Karl's brain into this body.

For the procedure Karl's brain is removed and placed in a liquid filled open top jar (hopefully the liquid is sterile and some sort of buffer – and not formaldehyde - to help keep delicate brain tissues functional). The 'blood' coagulated into droplets and schlieren patterns can be seen in the liquid suggesting some sort of oil phase as a diluent, something not particularly friendly to tissues (perhaps formaldehyde?).

After the brain transplant an electrical current is passed through the body of the monster. In a galvanic-like response severe muscular contractions occur. These contractions may be the result of the electrical current and not necessarily a sign of a functioning brain. Even so, the Baron says, "His brain will take some time to adjust itself to his new body", which is a true statement. It will take time for all cranial nerves to adjust to their new attachment sites not to mention integrating all brain functions into normal biological actions of the body.

In explaining his brain work to Kleve the Baron says, "In my early experiments with a live brain I used reptiles. I removed the brain from a lizard (what species?) and replaced it with a frog's (again, what species?). The lizard attempted to jump but of course it was physically incapable (note: lizards can readily jump). But it proved my theory. The brain will continue its normal function regardless of its

environment. Later I used anthropoids (i.e., primates). I gave Otto (a chimp) the brain of an orangutan.”

Baron says to the ‘new’ Karl (Karl’s brain in the new made, not born body), “You’ve made wonderful progress in the last week.” This ‘new’ Karl has all faculties and physical abilities so all the cranial nerves must be successfully attached and all portions of the brain working correctly. The new Karl’s physical actions are “excellent”. His speech center is functional; the new Karl can talk, think, reason, and respond. Later, in an interesting development, paralysis returns to the new Karl with a lame right leg and arm, similar to what he had in his old body. This is a disease of the mind (psychosomatic?) and not of the brain. If there is any damage to the brain here it is mostly of a psychiatric nature and not physical.

Later in the film, once the Baron has been exposed as the real Baron Frankenstein, he is severely beaten by his patients. As Kleve explains, “they went mad and tore him to pieces.” Kleve acts quickly and then transplants the Baron’s brain into a new body thereby preserving the Baron’s brain and mind.

For the procedure we see the removed brain, which appears small (in reality, probably a sheep brain), and is placed into an open top liquid filled jar (again, hopefully not formaldehyde). Kleve then transplants the Baron’s brain into a new body; apparently a successful operation since the new Baron is now known as Dr. Franck. A barely visible scar is seen across the forehead of Dr. Franck, a remnant of his head surgery.

#### *Evil of Frankenstein (1964)*

The Baron has stitched together another body and this one was brought to life by an electrical storm. Once revived the monster seems to have all his mental faculties. Later as he wanders around the lab he is slow and lethargic; not sure if this is a neuromuscular problem or a mental problem. Throughout the course of the film the monster does not talk so it is unknown if his Broca’s brain area is affected or not (maybe his tongue and hypoglossal nerve are not functioning so he is unable to speak).

As things go in Hammer films the monster is shot in the head (right side?) – so he has brain trauma - and later found frozen in ice. “He’s alive but his brain is dormant”, says the Baron. He was revived though not responsive. It is clear the monster initially has no pain sensations, as processed by the brain, since the monster felt no pain of a lit candle to his hand causing the Baron to comment, “The brain is intact...the cellular structure complete, the whole metabolism as it should be then why will his brain not function?...he needs some sort of mental shock.” What this means is the monster does not have a physical problem with the brain but, rather, a psychiatric problem, a disease of the mind.

As a solution the Baron gets hypnotist, Zoltan, to help control his monster. Zoltan says, "You want me to hypnotize someone...there's not a man born of woman that I can't put under." The Baron responds, "He has a good brain and excellent eyes...I won't tell you where I got them but I can assure you they're perfect...I want you (Zoltan) to stimulate his brain, start some train of thought, anything to act as a catalyst...accelerate a reaction in his brain."

After Zoltan revives the monster he goes beserk from awakening from the hypnotism. The Baron comments, "His brain hasn't healed yet." Through hypnotism the monster obeys Zoltan's commands and carries out his orders and not those of the Baron's. In the end the monster eventually destroys the lab.

#### Hypnotism of the brain

Hypnotism or hypnosis is an altered cognitive state of mind in which a person is responsive to suggestions. The hypnotic subject is in a trance-like state and focused on a single task. Those undergoing hypnosis show marked changes in their occipital, prefrontal, and temporal areas of the brain, which is one of the reasons why those in a trance experience deep relaxation. Hypnosis typically is used to alleviate some psychological and psychosomatic disorders. As such, this 'evil monster' must have functional occipital, prefrontal, and temporal lobes in order to be susceptible to hypnotism.

#### *Frankenstein Created Woman (1967)*

##### Baron the corpsicle

The Baron is working on cryopreservation and after keeping himself cold (frozen?) for one hour he is successfully revived, albeit with electrical shocks and smelling salts. The point the Baron wants to make is all the body's components, both physical and metaphysical, can survive being frozen. At the time of the film's action, late 19<sup>th</sup> Century, refrigeration technology was some distance in the future so at best the coldest the Baron got was a few degrees below freezing in his isolation chamber and not an ultra cold temperature.

#### The cold facts of cryopreservation

Suspended animation is a process that greatly slows or stops metabolic processes. Can someone really be put into a state that resembles death and then revived? For individual cells, yes, but for entire bodies the technology is not there yet. It is noted that freezing produces ice crystals both inside and outside of cells which can damage subcellular structures in bodies and render organs non-functional.

Actually, lessons can be learned from hibernating animals. About 6 of the 34 Orders of mammals have species that hibernate. In hibernating animals breathing and heartbeat are significantly slowed but not stopped. Brain wave studies suggest that hibernation resembles a deep sleep. In hibernation or in the case of the frozen Baron the thermoregulatory center of the brain is affected.

The human brain can not make its own glucose (energy) so it depends upon blood flow to deliver glucose for metabolic processes. The human brain weighs about 2% of body weight, receives 13% of the blood flow, and consumes 20% of its oxygen. With these values then humans would die if we hibernated like other animals. Its all about oxygen availability. No matter what, human brains need oxygen. Even under suspended animation for an hour as like the Baron then some brain damage could occur. Most likely this is hypothermia in which the core body temperature falls from a normal 37°C to one below 35°C. When exposed to cold the brain's thermoregulatory center, the anterior hypothalamus, is activated. Blood vessels constrict in an attempt to maintain body temperature and shivering occurs, which depletes body energy that will ultimately affect the brain; less oxygen due to constricted blood vessels and therefore less available energy to the brain.

#### Time to chill out

How does the human body respond to cold? There needs to be a balance between energy production and utilization with the changes in body temperature. For example, at internal cold temperatures blood tends to clot so there must be processes that inhibit this and that takes energy. For every degree fall in core body temperature blood flow to the brain decreases about 6%. Brain function is critical so it does not take much to disrupt oxygen delivery by blood. The colder it gets the more body functions either slow down or become non-functional. With enough decrease in brain blood flow then brain damage will occur, the severity depending upon the time kept at ultra-cold temperatures.

Frankly, what the Baron did in his cold chamber is nothing more than, say, attending a football game at (outdoor) Lambeau Field in Green Bay, Wisconsin, during January. The Baron was fully clothed and in the chamber for "precisely one hour" so his core body temperature did not significantly dip where natural bioprocesses would be at risk.

#### Christina the woman

Christina Kleve, Hans' girlfriend, is deformed with a scarred left side of her face and stiff left arm and leg that does not bend at the knee. Hans is beheaded for a murder he did not commit and his girlfriend, Christina, so distraught over this, suffers from so much mental anguish and shock, that she drowns herself. Upon examining her drowned body the Baron explains Christina's deformed condition to his colleague Dr. Hertz, "A blood clot somewhere near the brain. Nothing you can't put right...in 6 months time she will be as good as new, better." (Note: a blood clot in the brain would cause increased pressure which could constrict blood vessels minimizing oxygen to the brain causing even more problems. She could have had a mild stroke due to the blood clot.) The Baron and Hertz revive her but she has a psychic connection with Hans, her lover. Hans' brain (anima or essence or as the Baron surmises, his "soul") is transferred into the body of Christina by the Baron. It is Hans, channeling through Christina, who takes care

of retribution over those who framed him for murder. It should be noted that no physical brain is seen in the film.

*Frankenstein Must Be Destroyed* (1969)

Earlier, the Baron and Dr. Frederick Brandt were involved in some brain experiments. In explaining this the Baron comments to his assistant, Karl, "We were involved in the problems of transplanting the human brain. We both achieved it... We had both found a way of making an immediate transplant from one body to another...Our next step was to find a way of freezing brains without destroying living cells so they could be stored for future use. My research went badly (how badly? Were the authorities involved?) but Brandt discovered the technique...we were seeking to preserve for all time the great talents and geniuses of the world. When they die their brains are at the height of their creative power...we want to remove those brains at the instant of death and freeze them thus preserving for posterity all they contain." Quite noble sentiments but we know the path to Hell is paved with good intentions, especially for the Baron.

Unfortunately, Brandt went insane before he could give the Baron his procedure for successfully freezing brains. The Baron then conceived a scheme to transplant Brandt's brain into a new body hoping the procedure will 'awaken' the insane brain. To achieve this the Baron and Karl prepare the two bodies for brain transplant. For the procedure the Baron uses a surgical saw to remove the skull from Brandt. Then the skull and brain are removed from the second body and Brandt's brain transplanted in its place. "Quickly", says the Baron. The transplanted brain was temporarily kept in a (non-sterile) liquid tank. This brain appears to be a product of the special effects department and not one from nature.

Afterwards, Karl comments, "Utterly fantastic" to which the Baron responds, "Not fantastic, Karl, advanced. The transplanting of all human organs is a logical branch of surgery." The real issue here is not in the brain transplant per se but in the proper connection of the twelve cranial nerves so they are functioning normally.

The Baron says, "The insanity (of Brandt) was caused by pressure on the motor area of the brain. The pressure must be removed and the cells that have been damaged must be destroyed." The Baron then uses a surgical drill and drills a hole through the skull and into brain matter. Based on the size of the drill bit (3/32"?) it is a small hole. He then places a trochar needle into the brain to a depth of about 4 inches. "In two days I shall wake him just enough to elicit response." The insertion of such a small trochar would do nothing to alleviate any perceived pressure on the brain's motor area.

After the procedure the patient responds to verbal commands suggesting his brain functions are normal. Later, he has no problem talking to his wife so he has complete control of his mental faculties.

All this activity, including murder, to get the information from his colleatue on how to successfully freeze brains demonstrates the single minded drive of the Baron to get his work done. Freezing a brain is one thing but successfully reviving it is beyong current technology.

#### *Horror of Frankenstein (1970)*

The only film in the series in which Baron Victor Frankenstein is not played by Peter Cushing but, rather, by Ralph Bates.

The Baron comes across road robbers and two are killed. The Baron ignores the one with a bullet in the head and removes the head of the one with a bullet to the chest. The Baron keeps the head immersed in a large jar of preservative liquid. Presumably, formaldehyde and, if so, then the brain would be completely useless.

In his lab the Baron begins to assemble the body of his creation. The Baron sectors out anatomical regions of a body and begins his search for parts to complete his human creation. The brain for his creation, labeled as 'part 25', comes from Professor Heiss. The Baron saw to Heiss's demise and once buried was dug up by a gravedigger who removed the head. The Baron then removes the brain and also places it in a jar of (presumably non-sterile) preservative liquid. This brain is a washed out gray color, not typical of what a brain should look like. The Baron uses his ungloved hands to remove the brain from the jar so immediate contamination occurs.

The brain, the last part for the Baron's creation, is successfully transplanted into the body the Baron stitched together. The awakened monster then escapes the lab and wanders into the woods. The Baron finds the monster and hits him over the head with a large tree branch no doubt causing trauma to the head and brain. Initially the monster does as the Baron commands but is inadvertently destroyed in a vat of acid.

#### *Frankenstein and the Monster From Hell (1973)*

In this film the body of Herr Schneider becomes the monster ("I dug him up again" responds the Baron). Before the sedative wore off of the monster – and the pain started - the Baron comments, "I removed a section of the sensory area of the brain that made him unaware of his agony...a crude effort but effective."

Simon, the Baron's assistant, attaches eyes to the monster which means he attached the optic nerves to the brain. Since the monster can see suggests the eye implants (and nerve attachments) were successful. The Baron comments,



“He saw me. He can see!” The Baron says, “Now all he needs is another brain. The brain of a genius.”

### Brain operation

Under the Baron’s supervision (his hands were destroyed in a fire making them useless for delicate surgery) Simon removes the brain of an inmate of the asylum, a “Professor Durendel” (read: genius). Simon first saws off the skull exposing the brain (no doubt the saw was not sterilized). The Baron instructs Simon through the procedure as, “First, you lift the frontal lobe and you cut the optic nerves. There are six...leave the ligaments as long as possible for the transplant...now the left cerebral hemisphere. You cut the cranial nerves. There are six of them too...now the right cerebral hemisphere. Now you will need the scissors. I will ease out the entire brain and you can get to the spinal cord. A nice clean cut.” The Baron then places the just excised brain into an open jar of aerated liquid with bubbles from a filter, similar to those used in fish tanks.

Later, the Baron examines the brain which is placed in a metal tray commenting, “No damage, no damage at all. A small tumor. We can get rid of that.” (If the tumor is cancer then it is highly dubious he could “get rid of that”!). The brain is momentarily left in the open tray on a lab bench. Then the Baron places the brain into another open jar of liquid. Overall, a complete lack of sterile technique on every level so it is highly likely the brain will get an infection which may be fatal or, in the least, cause inflammation and possibly localized swelling. If the brain is severely infected then this contamination will be introduced into the body once the brain is transplanted further jeopardizing the health of the monster.

With the continued guidance of the Baron, Simon then transplants the brain into the skull of the monster. Simon does the surgery while the Baron directs. Simon first removes the brain from the monster and then “reverse the procedure” and replace it by transplanting the professor’s brain into the monster’s skull. Apparently the surgery is successful since the monster is aware, cognizant, and can speak. Simon comments to the Baron while toasting their success, “One man’s body, another man’s mind.”

In the end the Baron comments, “We failed...the body hasn’t accepted the new brain, it’s trying to reject it. In a few days it will succeed. Then the brain will begin to deteriorate, decay, and finally rot to nothing. The man will become a cabbage and he will die.” Simon responds, “It could be the brain just needs more time to adjust itself.” This is a comment more appropriate for mental issues than physical issues and Simon should have known better. Tissue rejection is an immediate effect and not one that will adjust itself over time like the healing of a fractured bone.

### **Summary**

His brains have brains

Much can be learned from the brain surgeries in these films. The neverending discovery of what the Frankenstein franchise has to offer shows how rich and storied these films are. Hammer brains have a unique niche in the horror film pantheon. Other film franchises may show something similar and perhaps even more graphic but for a consistent showing of brains these Hammer Frankenstein films stand alone. Though we graphically see brains and their removal in none of these films do we see the procedures of transplanting a new brain into an old body. In the least these films show the Baron is a superb surgeon. However, in the end, the Baron is more interested in the monster's nature than the monster's nurture. Simply stated, the Baron cares more for the monster's brain than his mind.

Essentially, no matter what happens to their brains or who they came from it appears each of the monsters has at least some sort of basic cognitive reasoning and though they can move about and respond to commands, though apparently not much more than that, they all seem to have some brain impairment issues. Based on these impairments then reasonable guesses can be made about which areas of the monster's brains were traumatized (see Table). Depending on the monster he can have frontal, parietal, and/or temporal lobe problems, his cerebellum most likely has some damage as well as his brain stem and amygdala. Since each monster's heart rate, breathing, and digestion appear normal then his hypothalamus and autonomic nervous system are functional. It is noted that the monster does not speak in many of the films suggesting his Broca's brain area and/or hypoglossal nerve may also be traumatized.

Over the course of the films Hammer brains have experienced much trauma so it is no surprise that the monsters in the films all have mental and resulting physical issues. It is clear that the Baron is a master at surgery but without complete cognitive abilities of the monster then his work is incomplete. It's like making an airplane with an inadequate engine so no flight. The Baron apparently does not care about looks but only on the success of a brain transplant. Does the made, not born monster behave as a normal human? What are the expectations? What level of success does the Baron want to achieve? Apparently, looks is not one of them so what is his end game? Just bringing a body back to life or is there more?

After the first film, *The Curse of Frankenstein*, and in each subsequent sequel the good Baron always tries, one way or another, to overcome the trauma caused by Krempe when he shot the monster in the head. In one respect all the subsequent work done by the Baron is due to the actions of Krempe. The Baron failed the first time which gave him the incentive and motivation to continue his work, irregardless of the consequences or who gets hurt. His goal supersedes all other issues, moral, ethical, or otherwise. For this the Baron frequently moves from town to town to escape prying eyes, persecution, and the guillotine. As the Baron comments (from *Frankenstein Created Woman*), "What does right have to do with it" ('it' meaning getting bodies, brain transplants, even committing

crimes). This is how the Baron justifies his work. He does not care about “right” and to him his end justifies any means necessary. Afterall, he is the resident Hammer genius, the brains behind the work.

Thank you for reading. It’s back to the lab for me. Stay healthy and eat right.