

## Dracula's House of Science

By Mark C Glassy, Ph.D.  
copyright©

### Introduction

The film, *House of Dracula* (HOD), contains the most remarkable, relevant, and prescient science in any of the Universal Studios' Frankenstein films. To me, this film is a non-guilty pleasure to be enjoyed on its own merits. This film was made in 1945, fairly primitive for today's biomedical science, but some interesting and accurate science was nonetheless not only discussed but also demonstrated. And on the other side of the coin there is also some remarkably naïve and amusingly incorrect science too. Though HOD does have the usual plot holes and inconsistencies it nevertheless does have much to offer.

### Plot Synopsis

Of his own free will Dracula, under the guise of Baron Latos, visits Dr. Edelman hoping for some sort of cure for his vampirism. Larry Talbot also visits Edelman hoping he too will get a cure for his lycanthropy. While searching for Talbot, Edelman comes upon the body of Frankenstein's monster in a cave. After bringing the monster to his lab Edelman infuses an electrical charge into him giving him vital strength. In attempting to cure Dracula via immunotherapy Edelman was contaminated with Dracula's blood turning him into a murdering mad scientist. Edelman was able to use a fungus extract to relieve pressure on Talbot's skull thereby stopping the lycanthropy symptoms. The revived Frankenstein monster goes berserk and accidentally sets the lab on fire seemingly destroying all contents, including Edelman as well as the monster himself.

For the film, HOD, a diverse cast was assembled and consists of Dracula, the Wolf Man, Frankenstein's monster, a hunchback (probably the prettiest hunchback in all SF cinema), and, of course, the proverbial mad scientist. The scientist, Dr. Edelman, tries to do it all by developing not only a cure for Dracula's thirst for blood, but also a cure for Larry Talbot's lycanthropy, not to mention the means to resurrect the Frankenstein monster. He was busy and all of this in a mere 67 minute long film.

### Dr. Edelman the man

Though Edelman could be considered a mad scientist he is driven to that extreme as a victim of an incident by the contamination of Dracula's blood parasites (see below). In keeping with the theme of these articles Edelman is more of an annoyed scientist though one driven to madness by circumstances.

Our first glimpse of Edelman is of him sleeping in an easy chair when he is awakened by Baron Latos suggesting he has had a long night of work and dozed off in his

chair. Scientists keep open hours often dictated by the work at hand. Long, laborious work requires long, laborious hours. All this suggests Edelman cares about his work, indicative of a good scientist.

#### Enter Dracula...er, Latos...er, Carradine

Baron Latos, actually Count Dracula in disguise, “freely” enters Edelman’s home around 5am one morning, without being invited. (Perhaps he was invited into the house some time before and that invitation still holds.) Latos has decided that he wants a cure for his vampire affliction so he sought out Edelman and convinces him to help. “I will explain everything before sunrise”, says Latos who has stored his coffin in the basement of Edelman’s castle. This justifies the film title, House of Dracula (which should actually be the ‘Castle of Dr. Edelman’).

#### Doctor to patient discussions

In a conversation Latos and Edelman discuss vampirism and Edelman says, “Certain physical aspects of vampirism are OK...upset metabolism, reduced appetite”. In this way, Edelman accepts natural physiological changes but balks at any supernatural changes. Edelman continues, “cases have been recorded in which the victim, driven by some abnormal urge, actually believes that the blood of other people is necessary to keep them alive. Became psychological killers in order to obtain it. These beliefs probably upset their metabolisms, induced fixations, lustful appetites.” Some diseases do indeed cause such behavioral changes.

Latos reveals himself to Edelman by saying, “I am Count Dracula. But I am known to the outside world as Baron Latos. You see before you a man who has lived for centuries. Kept alive by the blood of innocent people. I have come for you to seek a release from the curse of misery and horror” (at least Latos recognizes he has a problem which by itself is a significant development). Continuing, Latos asks Edelman, “You could affect a cure?” Edelman understands Latos’ condition and comments, “It will be a challenge to medical science.” A challenge he accepted.

#### Edelman’s castle lab and clinic

It seems that in every SF and horror film, if the protagonist has a ‘castle’, this one located right on an ocean coast, it invariably has its own lab. Edelman is no exception and his castle mansion lab is one of the best equipped and laid out labs in the Universal Studios’ Frankenstein films if not all of SF cinema. This well-equipped and stocked lab has copious amounts of glassware, flasks, beakers, countless test tubes and racks, Bunsen burners, pan balance, mortar & pestle, eyedroppers, a very nice binocular microscope, two autoclaves (!), shelves of books, chemicals, reagents, large volume glassware mostly filled with liquids, along with various assorted bench bling. Metal instruments like clamps, tweezers, and many storage shelves are also seen. Perhaps the most amazing of all are the two autoclaves! Autoclaves are used to sterilize items by super heat with high temperature and pressure. Typically, glassware and metal instruments such as needles, scalpels as well as fluids that need to be sterilized are autoclaved. However, neither of the two autoclaves seen in the film have exhaust ports for cooling down so they most likely

were just placed in a convenient spot without hooking them up properly. Nevertheless, it is nice to see such particular lab dressings.

Also scattered about the lab proper are examination tables, elaborate organic chemistry columns, evaporators, titration columns, trays, pans, full cabinets, tables, notebooks, clipboards, and on and on. Some of the flasks and test tubes have cotton plugs suggesting sterile samples. (Russell Gausman, the standard bearer at Universal Studios for dressing all sets, and his staff must have had a grand time dressing this lab.) Lab benches and carts are also well stacked with plenty of laboratory and medical supplies. Also visible are various wires, tubes, overhead lights, various non-descript instruments, apparatus, and other large pieces of electrical equipment.

In addition to the lab is a well-designed and functional walk in warm room, the humidity chamber, where the plants are housed. The plants are in individual trays, some on the floor and some on a metal bench. Also present in the warm room are shelves with large Erlenmeyer glass jars with cotton plugs and a metal sink.

On Edelman's desk are a microscope, a test tube rack (with 8 test tubes), reagent bottles, notes, notebook, papers, etc. A dedicated lamp on the desk for the microscope is a nice touch. All in all, a busy, cluttered desk indicative of someone getting work done.

#### Hematology

This film may be the first time Dracula undergoes any type of medical exam. It is amusing that at sunset Latos emerges from his coffin and reports to Edelman for a checkup. In the course of the exam Edelman obtains a sample of Latos's (aka, Dracula's) blood and upon entering his lab he approaches his assistant, Nina, and asks her to "Make a blood smear of this", meaning prepare a glass microscope slide with the blood sample for analysis. Nina uses standard hematology procedures of placing the blood sample on a glass slide and preparing it for Edelman. This is performed so smoothly it is believed that the character, Nina, has done this countless times.

#### Down the microscope

We get a nice point of view shot of the blood sample and the observed field has about 100 red blood cells (RBCs), one white cell (a polymorphonuclear leukocyte), and six "parasite" organisms, each wrapped around one RBC (for more on parasites please see the article, "Microbes in Science Fiction Films", in *Scary Monsters* #96). These parasites have long, thin arms that branch out to finger-like projections (either three or four). No such parasite exists in reality though there are those that do indeed specifically attack RBCs, malaria being one such example. (For a background on microscopes please see the article, "The Microscope in Science Fiction Films, in *Scary Monsters*, #90.)

#### Dracula's parasites

After seeing these two and three armed cellular structures Edelman tells Nina to “make a culture of this and prepare an antitoxin as soon as possible.” Here Edelman identifies the unknown parasite as a “toxin.” (For details on toxins please see the articles, “Poisons, Toxins, and Venoms”, part one in *Scary Monsters* #110 and part two in #113.) “All right, doctor”, replies Nina demonstrating she is a good lab assistant who is willing to do the impossible to please her boss.

Culturing parasites is not a straightforward process since proper growth conditions must be met with the most difficult problem being which nutrients to use. To work out optimal growth conditions could take some time, perhaps months. Once done, then the process of generating an “antitoxin” or antiserum can begin. To prepare an effective antiserum would take months by itself since a host animal (usually goats or rabbits) would need multiple immunizations, done over many weeks, with a parasite extract so there must be plenty of parasites available for this. In total there could be several months of work involved and, meanwhile, Latos is still suffering from his vampire condition.

The parasites appear to feed off of RBCs and if true this provides an interesting mechanism of action which Edelman quickly surmises. The parasites deplete the RBCs which is why Latos/Dracula is in constant need of new blood. He needs to constantly replace the RBCs that the parasites destroy on a daily basis. What this really means is Dracula does indeed have a biological need and, as such, once a need is understood then a cure can therefore be developed to counteract the parasite biology. This is why Edelman wants to “prepare an anti-toxin” thinking that the parasite is the root cause of vampirism. In a remarkable bit of prescience Edelman correctly reasoned that the observed Dracula parasite may be destroyed by using the power of the human immune response via an anti-toxin.

#### Dracula’s parasites

After analyzing the preliminary data Edelman says to Dracula, “It appears I may have to alter my theories. An examination of your blood reveals the presence of a peculiar parasite, the form of which I am completely unfamiliar. It’s possible that it may have something to do with your problem...I am having an anti-toxin prepared so we can see...a pure culture of the parasite introduced into the parent bloodstream will destroy not only its own kind but themselves as well.” Latos then asks, “These treatments will take some time?” Edelman responds, “Without a doubt”. In theory, this is correct and the basis behind vaccines. Edelman responds quickly with, “We shall start treatments tonight, a transfusion.”

A key step is missing here in the generation of an antitoxin, namely the use of “attenuated parasites”, meaning an intact parasite that has been damaged in such a way that it can no longer replicate and therefore no longer a biological threat. This is essentially how vaccines work through the use of an attenuated version that can no longer replicate but still stimulate an immune response from the patient. In general, vaccines stimulate antibody production in humans and these antibodies neutralize the effects of the invading antigen or germ. This is what Edelman wanted to do with

Latos, namely use the Baron's vaccine-stimulated immune response to destroy the parasites.

### Immunology of Dracula

The development of a vaccine is a long and labor-intensive process. It should be noted that parasites are complicated organisms and it is unclear how well they can stimulate an effective and long-lasting immune response. (For example, scientists have been working for decades on a vaccine for malaria with limited success. On the other hand, vaccines against measles have been relatively easy to make and very effective. It all depends on the nature and lethality of the invading parasite's antigens.) This is assuming, of course, that Latos himself has a fully functional and robust immune system and not one that is incomplete and therefore one incapable of mounting an effective immune response against the parasites. Patients who have an incomplete or sluggish immune response are referred to as being immunocompromised. Their immune system does not work well so they are more susceptible to infections and diseases.

### Symptoms of the parasite

RBCs contain the protein hemoglobin and each hemoglobin molecule contains four heme groups, each with an iron molecule. Hemoglobin, the carrier of oxygen, is the major protein in RBCs. Since the parasite breaks down RBCs then these blood cells release the large amount of hemoglobin proteins they carry. Excess heme, the iron containing center of hemoglobin proteins, in blood circulation can result in certain diseases. Porphyrin is a group of genetic diseases in which porphyrins, breakdown products of hemoglobin, negatively affect skin and the nervous system. Symptoms include abdominal pain, confusion, high heart rate (tachycardia) and blood pressure (hypertension), and vomiting. Complications include paralysis and seizures. Porphyrin, essentially defects in heme production, is an inherited condition from parents and due to a mutation in one or more genes that make heme. Heme biosynthesis is mitochondria regulated since four of the eight genes needed to make heme are located in mitochondria, an organelle located within each cell.

When excess porphyrins accumulate in the skin then local skin damage can occur.

Porphyrins are photosensitive and exposure to sunlight can cause severe pain, burning, redness, and discomfort in the exposed areas. In some cases blistering can occur.

Certain drugs can trigger porphyria by interacting with enzymes in the liver where heme is made. Some porphyria patients are sensitive to sunlight and suffer from anemia, a key feature of Dracula. However, it should be noted that people with congenital porphyria do not crave blood. The enzyme (hematin) necessary to alleviate symptoms is not absorbed intact on oral ingestion and therefore drinking blood would have no beneficial effect on the patient.

### Human antibodies at work

In a remarkably prescient observation Edelman reasoned that the antibodies in his own blood may counteract the parasites in Latos's blood so he gives Latos a transfusion of his own blood. This transfusion is the first treatment of Latos' vampire condition and may be one of the first examples of immunotherapy in SF cinema. Though not totally clear how much blood was transfused the transfusion appears to be about 10cc of blood, enough for a large tablespoon, from Edelman into Latos, for each pull of the syringe. (How many pulls? If a typical unit of blood was given then there were about 50 pulls on that syringe!) Both Latos and Edelman are on gurneys for the transfusion which Nina oversees. Since Latos easily survives the transfusion their blood types must be compatible. Otherwise the blood would be immunologically rejected with potentially life-threatening complications. It should be noted that Latos receives an arm needle stick for the transfusion procedure which heals suggesting he has functional wound healing mechanisms (i.e., blood clotting factors).

Later, after obtaining some lab data, Edelman says to Latos, "This photomicrograph of your blood reveals an odd condition. One which I can't account for as yet. A different species of 'anti-body' has appeared." Latos responds, "Why worry as long as the treatments are proven successful." Edelman says, "As a doctor affects a cure he wants to know how he did it." Latos responds, "That's little concern to the patient as long as he is being cured." (A true sentiment since most patients just want the medicine to work and not care how it works. A similar sentiment expressed by Larry Talbot; see below.) It is difficult to understand how a photomicrograph, essentially a normal sized photograph of small cells, can show a nanoscale antibody biomolecule appearing. Tests for antibodies, especially during 1945, the time of the film's production, were done using an entirely different procedure, one based on diffusion through agar, so no photomicrograph could give such data.

In a subsequent blood transfusion procedure Latos puts the whammy on Nina and subsequently reverses the blood transfusion thereby contaminating Edelman's blood with Latos's (aka, Dracula's) blood. The volume of transfused blood appears to be about 10cc. In acknowledging the problem, Edelman says, "My blood has been contaminated by the blood of Dracula." The parasite (slowly) takes over Edelman. First symptoms are physical like a darkening of the eyes and with hair, beard, and moustache mussed up. With this altered physical appearance he looks sinister and psychotic, perhaps even mad. The symptoms of the parasite infection increase over time which ultimately leads to murder.

In the end, no matter what Edelman did for Latos it is the rays of the sun that destroys Dracula...again.

### Lycanthropy

Larry Talbot, the Wolf Man, sought out Edelman hoping the good doctor can cure him of his lycanthropy curse. Talbot asks Edelman, "Do you believe that a man can be transformed into an animal?" Edelman responds with, "Anything can happen in a person's mind." Taken to a jail cell for observation we see Talbot undergo his

personal hell as he transforms into the Wolf Man with nowhere to go and no one to attack.

As a patient Edelman performs a physical exam on Talbot and surmised that swelling of his brain is the root cause of his lycanthropy. During the discussion it is disclosed that part of the exam included x-rays of Talbot (probably of the head and chest). This suggests that Edelman has an x-ray machine (and all that goes with this technology) somewhere in his home lab!

At a subsequent examination Edelman says to Talbot, "In your case, my boy, diagnosis is extremely difficult...examination discloses one condition, pressure upon certain parts of the brain. This condition, coupled with your belief that the moon can bring about a change, accomplishes exactly that. During the period in which your reasoning processes give way to self-hypnosis, the glands which govern your metabolism are out of control. Like a steam engine without a balance wheel. When this happens the glands generate an abnormal supply of certain hormones. In your case, those which bring about the physical transformation which you experienced." This is one of SF cinema's early use of the word, hormone. A distraught Talbot responds, "Explaining it doesn't help. What can you do about it, operate?" Edelman says, "A surgical operation to enlarge the cranium cavity is a long and dangerous one."

#### Enlarge the Cranium / Lycanthropy on the brain

According to Edelman the pressure on Talbot's brain, caused by a tight cranium, triggers an hormonal imbalance which results in lycanthropy. It is known that pressure on the pituitary gland and the hypothalamus in the brain can cause both metabolic and psychological changes, some of which can be severe.

#### Cerebral edema

Pressure on the brain or swelling is a fluid buildup called edema and typically is a response to some sort of injury or infection. A common example of a brain injury with edema is a concussion. In many cases the edema happens quickly and can readily be treated by rest and ice. More severe cases may require the removal of excess fluid. The thick bony skull snugly holds the brain so there is little room to swell which is why, if not treated, the build-up of pressure from edema can become critical and in severe conditions can result in death. Swelling of the brain can occur in the entire brain or in specific locations depending upon the cause. This is of interest based on Edelman's comment of, "pressure upon certain parts of the brain", suggesting that in Talbot's case his entire brain did not swell, just certain parts.

The most severe complication of cerebral edema is increased intracranial pressure. This can destroy delicate brain tissues and can prevent blood from flowing to the brain and if deprived of oxygen and other nutrients for too long can result in brain damage. Perhaps even fatal.

Short term effects of cerebral edema may include agitation, confusion, disorientation, nausea, and vertigo. Some long term effect may include anxiety, cognitive and language difficulties, depression, dizziness, fatigue, headaches, inability to think clearly, insomnia, and memory issues. It is clear that after a transformation episode Talbot experienced some of these effects.

There are a variety of treatments available for brain edema. Some of these consist of: oxygen therapy – provide oxygen through a respirator; intravenous (IV) fluids – giving fluids helps prevent a loss of blood pressure and making sure the brain is receiving enough blood; lower body temperature – hypothermia helps relieve edema allowing the brain to heal; medication – a variety of drugs are available to help relieve edema such as diuretics, anticonvulsant medications to prevent seizures, and barbiturates; ventriculostomy – a small hole is cut in the skull for drainage of excess fluids to help relieve pressure; and surgery – removing part of the skull (called decompressive craniectomy), repairing a damaged artery or vein, or removing a growth.

What causes cerebral edema?

A number of factors contribute to brain edema, both genetic and lifestyle. Such factors as injury, stroke, infections, high altitudes, and tumors among other causes can result in brain edema. There is the possibility that Talbot has a small benign brain tumor that causes some internal cerebral pressure resulting in his condition. The mental anguish of seeing a full moon stimulates hormone production which could in a monthly pseudo-circadian rhythm mode bring about his transformations.

Brain edema symptoms

One of the first signs of brain edema is a change in consciousness. If the person becomes unconscious then symptoms consist of a change in behavior or personality, confusion, nausea, numbness, lack of coordination, and dizziness. Symptoms that Larry Talbot has shown. Once edema symptoms begin then progression can be rapid and depending upon the severity could take some time to fully recover, if at all.

Search for a cure

Edelman has a warm room or 'greenhouse' in his lab dedicated to just plant growth. This is more of a warm room and incubator than a real greenhouse since it appears there is only artificial light in the room and no sunlight. Therefore, this limits the level of ultraviolet (UV) light that hits the plants, a critical component of plant photosynthesis. Unless artificially provided, no sunlight means no ultraviolet light and no photosynthesis and therefore, minimal plant growth. It is unclear what UV light source Edelman is using to grow his plants.

Laboratory warm room

The walk-in warm room has shelves with large cotton-plugged flasks containing plant samples and name tags. It is assumed that the heat and humidity are confined to the warm room. In this room the mold is seen growing on plants and the spore filaments are picked off with tweezers. These flowering plants are in individual soil

boxes. Also seen in the room are other fruiting plants in pots. In reference to the warm room Nina says to Edelman, "Increasing the humidity was a good idea. The spores (see below) are multiplying faster than ever. If we can produce the mold in quantity think what it would mean to thousands of people all over the world." (Note: any worldwide disease limited to just "thousands" is classified as an orphan disease, meaning globally, few people have it. Very few people work on orphan diseases since the population pool is too small to develop cost effective treatments. This means that most orphan diseases are treated individually such as in the case of Larry Talbot.) While Nina was making these comments she is seen making a blood smear on a glass slide for Edelman to examine effectively demonstrating the multi-talented, multi-tasking nature of good lab assistants.

Note: The term *spore* derives from the Ancient Greek word σπορά *spora*, meaning "seed", "sowing", related to σπόρος *sporos*, "sowing," and σπείρειν *speirein*, "to sow." A spore is a walled, single- to many-celled, reproductive body of an organism, capable of giving rise to a new individual either directly or indirectly. Spores are a dormant reproductive structure that can survive for extended periods of time in very harsh conditions. Spores are part of the life cycle of many plants, algae, fungi, and protozoa. Biologically, spores are usually haploid and can develop into a new organism under favorable conditions. Some consider spores a germ cell or seed. Biochemically, spores have different biomolecules than their parent plants and these spore-specific biomolecules are what Edelman is interested in. The biological extract sought after by Edelman must be from the mold spores.

While looking at the warm room Edelman says to Talbot, "Under tropical conditions we've tried to duplicate here, this hybrid plant, *Clavaria formosa*, produces a mold from which we've been able to distill a substance which possesses a property of softening any hard substance composed of calcium salts. Bone, for instance. It might be possible without surgery to re-shape the cranium cavity thus eliminate the pressure." Continuing, Edelman says, "Unfortunately, it will take some time to produce mold in sufficient quantity." This is one of the first examples in SF cinema of biotherapy in which biological substances are being used to treat a symptom.

#### Bone-headed

Though bone is uniformly solid it is composed of a flexible matrix (about 30%) and bound minerals (about 70%) and the combination of the two results in a relatively hard though lightweight material. The bone matrix is hardened by the binding of calcium phosphate known as hydroxylapatite and the removal or inactivation of hydroxylapatite will make bone weaker. The removal or inactivation of hydroxylapatite in bone is an enzyme-driven process and, most likely, this is what Edelman focused on.

#### Fungus amongus

Note: *Clavaria formosa* is a many-branched yellow-tipped or pink coral-like fungus found in Asia, Europe and North America, not necessarily under "tropical conditions". The coral-shaped fruit body grows to a height of 30 cm (12 in) and width of 15 cm

(6 in). The yellow-tipped pinkish branches of *C. formosa* arise from a thick base. Terminal branches are less than 0.5 cm (0.2 in) in diameter. The flesh of the fungus is white, with pink in the middle, or pale orange. It may turn wine-colored or blackish when bruised. The smell is unpleasant and tastes bitter. It is thought to be mildly poisonous if consumed, giving rise to acute gastrointestinal symptoms of nausea, vomiting, diarrhea and colicky pain.



*Clavaria formosa* which does not resemble that seen in Edelman's warm room.

*C. formosa* produces a golden-yellow spore print. The spores have a cylindrical to elliptical shape and measure 8–15 by 4–6 $\mu$ m. The spore surface features small warts that are arranged in confluent lines. *C. formosa* basidia (spore-bearing cells) are club-shaped, measuring 40–60 by 7–10  $\mu$ m, and have one to four sterigmata. In the stalk, the hyphae comprising the flesh of the fungus are interwoven, while hyphae in the branches have a more parallel arrangement. Both types measure 4–13  $\mu$ m wide. Some of the hyphae are gloeoplerous, meaning they have an oily or granular appearance when viewed under the microscope. Clamp connections are present in the hyphae. Iron salts applied to the branches will cause a green color change.



*Clavaria formosa* spores at 500x magnification]

### No more full moons

In an attempt to end his lycanthropy curse a depressed Talbot jumps into the ocean but ends up being washed into a cave. Edelman chases after Talbot and once in a cave is attacked by the Wolfman. Away from the direct effects of the moon the wolfman reverts back to Talbot (If the Wolfman bit Edelman in the scuffle will Edelman himself become a werewolf from being attacked?) During the reverse transformation scene in the cave the Wolfman does not have a moustache whereas in the Talbot form his (thin) moustache reappears.

In the cave, Edelman notes, “The temperature and humidity down here are ideal for growing the spore producing plants. Before the next full moon we should have more than enough to help you.” In addition to the beneficial temperature and humidity conditions there is also considerably more space available in the cave than his small warm room so he should be able to grow more.

### Warm room #2

The *C. formosa* spore producing plants were moved from Edelman’s warm room in his lab down into the recently discovered underground cavern to take advantage of the optimal temperature and humidity. In the cavern Nina and Miliza are attending to the plants as horticulturists in their never-ending job description. In the film the harvested spores look like tufts of cotton on a small branched tree which does not resemble real *C. formosa*. These spore tufts are harvested by removing with tweezers and placed in a glass jar. It is noted that the hands of Miliza and Nina are gloved supporting the fact the fungi may have toxic components and the assistants wanted to avoid contamination on their skin while handling the spores.

### Pharmacognosy

The American Society of Pharmacognosy defines the term, pharmacognosy, as “the study of the physical, chemical, biochemical, and biological properties of drugs, drug substances or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources.” The Society further defines the term as, “the study of natural product molecules (typically secondary metabolites) that are useful for their medicinal, ecological, gustatory, or other functional properties.” Yes, a mouthful, but pharmacognosy can be simply stated as the study of plants as a source of drugs.

All plants, including fungi (such as *C. formosa*), produce a variety of chemical compounds, collectively called phytochemicals, as part of their normal metabolism and growth. These phytochemicals are either primary molecules like sugars and fats or secondary molecules that serve a more specific function unique to a specific plant. It is these secondary molecules or metabolites that are of interest and many have therapeutic actions that produce drugs useful in humans. Such examples are quinine, morphine, digoxin, alkaloids, phenolics, and terpenes so many pharmaceutical drugs have been derived from plants and other natural resources.

Based on all of the above, combined with the questions, what can potentially be extracted from spores, and what sort of lab apparatus Edelman has, then we can come to some sort of conclusion as to what the substance is that he used to bio-modify Talbot's skull. Considering this is the mid-1940s then what lab setups were available at that time must also be taken into consideration. No elaborate instruments here, just mostly do-it-yourself lab bling. The spores would be collected and an extract made containing the bone bio-modifying substance. The procedures to make the extract would require much glassware which Edelman has and some degree of sterility. The extract may then be further purified, a step also requiring much glassware, and subsequently analyzed using a variety of instruments and procedures which, again, Edelman appears to have. Later in the film we see Edelman's assistants extracting the substance from the spores using a variety of glassware setups (see below). All of these procedures would indicate the spore extract contains a biological substance and not a chemical substance, like an acid.

The spore extract that Edelman uses on Talbot to (slightly) enlarge his cranium would either have to be, as mentioned, a biological substance, like an enzyme (which may contain a lipid component), or a special type of acid that can soften bone. (An example of this some of you may know about involves, after a fine Thanksgiving dinner, soaking turkey bones in vinegar, a weak acid, for a few days. Afterwards the bones are so pliable that you can tie them into knots without the bone breaking demonstrating how strong bone bonds can be weakened with an acid.). The use of a spore enzyme, however, would be more interesting but the problem here is delivering the enzyme *inside* the skull at the right spot with the right dose to be useful, a tall order indeed.

### Biotherapy

The spore-derived biopharmaceutical "home grown" in Edelman's warm room is used to make Talbot's skull more pliable and able to accommodate brain edema. Edelman's theory is that the full moon makes Talbot's brain swell causing a hormonal imbalance resulting in lycanthropy. By making the skull larger to have room for a swelling brain would relieve the symptoms and therefore no more lycanthropy.

After Edelman's operation with the spore extract Talbot's head is seen covered with a plaster cover. It is unclear if the skull was opened up or what else was done to Talbot's cranium based on the plaster cover. However, soon afterwards, before the next full moon, we see Talbot with head bandages removed sprouting a full head of hair so apparently his head was not shaved for surgery suggesting at best a limited surgical procedure. This supports the idea of the spore extract being topical in nature. Nina comments, "What you've done would have meant an operation of the most delicate nature. This way, the dangers of surgery didn't even exist." Again, this comment supports a non-invasive surgical procedure that Edelman used on Talbot. Therefore, most likely what Edelman did was use a substance that absorbed through the scalp and acted directly on skull bone on the inside of the skin covering the head.

After Edelman's cranium surgery on Talbot Edelman comments, "We'll know in a few days." Apparently the biosurgery was effective since Talbot was able to see the full moon without changing. End result, Talbot cured. However, lingering questions remain: was Talbot's entire skull enlarged, the upper portion like a skull cap, or a ring of, say, about two to three inches wide, of skull bone around his head? Furthermore, did Talbot's skull remain enlarged or did it shrink back to normal size after some time? In other words, was the skull enlargement permanent or temporary? Lastly, once Talbot's cranium was enlarged thereby relieving the edema pressure then did his brain re-swell to an even larger size resulting in more edema pressure and another round of lycanthropy?

The spore extract Edelman used may be a collection of plant enzymes possibly in some sort of weak acid environment which are used to cure Talbot's lycanthropy by softening the skull bone and allowing it to expand to help suppress brain edema, the root cause of werewolfism. Based on the visible purification procedures then most likely the "purified" spore extract was not a single biomolecule (like an enzyme) but, rather, a combination of protein enzymes all pooled together. If true, then it would be difficult to determine which enzyme or combination of enzymes were the biologically active ingredient.

At the end, Talbot watches a full moon and does not transform. Since the biotherapy procedure worked on Talbot then will it also work on hunchback Nina? Unfortunately, she never gets to her promised land of no hunchback, a life without deformity, since Talbot shoots Edelman and kills him. This suggests that Edelman is not yet fully transformed into vampire status by Latos' parasites nor a werewolf from Talbot's bite or otherwise the bullet would not have harmed him.

### Frankenstein

In the cave where Edelman found the Talbot/Wolf Man they also discover the body of the Frankenstein monster along with the skeleton of Dr. Nieman (Karloff from the *House of Frankenstein* film) buried in quicksand mud. Apparently the mud acted as a preservative for the monster though not so for the unfortunate Nieman. It is of interest why the monster's skin is preserved and not Nieman's suggesting that the monster's skin is composed of different cells that may have sturdier keratins that help preserve skin. Are there natural preservatives in mud?

Upon examining the body Edelman comments, "The heart that Frankenstein gave him never died. The spark of life is still there. Waiting to be revived." And most likely still has those two bullets found by Dr. Wolf Frankenstein from the film, *Son of Frankenstein*. Furthermore, the monster has the brain of Igor as established in the film, *The Ghost of Frankenstein*.

At Edelman's castle lab the monster is put on a gurney and we see a lot of "eleck-strick" apparatus, courtesy of the inventor, Kenneth Strickfadden, the electrical wizard who assembled all those sparking gizmos, sparking away. For this film galvanism is still

at the heart of reviving/revitalizing the monster and Edelman uses high voltage electricity to restore the monster to his full strength.

Realizing the problem of having a fully revived monster Edelman says, “Frankenstein’s monster must never wreak havoc again.” However, after being contaminated by Dracula’s blood Edelman turns rogue “mad scientist”, with a Mr. Hyde-like alter ego, and now wants to bring back the full energy of the monster (similar to what Dr. Mannering did in the film, *Frankenstein Meets the Wolf Man*). Though all of this is of interest it must be acknowledged that the monster has a minor role in HOD with seemingly no real purpose.

#### Nurses & assistants

Nina is the hunchback nurse assistant of Edelman. Edelman claims he can ‘cure’ Nina of her hunchback using his spore extract bone treatments. Miliza Morel, though identified as another nurse for Edelman, does much more than typical nurse duties. It should be noted that all throughout the film both Nina and Miliza wear typical nurse uniforms of the mid-1940s, complete with white hats and shoes and not lab assistant attire.

A certain amount of the spore extract is needed for Edelman’s planned procedures so he asks Nina, “How much of the spore concentrate do we have? Is it enough for two operations?”, meaning one to cure Talbot’s lycanthropy and one to cure Nina’s hunchback. Nina responds, “No, there won’t be for some time.” Edelman then asks, “We do have enough for one?” Nina says, “yes”, and in a moment of self-sacrifice asks Edelman to use what they have on Talbot first. She could “wait a little longer.” Back in the cavern warm room, Nina and Miliza attend to the plants harvesting more spores. Then, Nina and Miliza are seen preparing the spores and harvesting the spore extract through a series of extraction and purification steps using several glass columns in the lab. They can do it all.

#### Hunchback of House of Dracula

Kyphosis (from Greek *κυφός* *kyphos*, a hump) is an abnormally excessive convex curvature of the spine, commonly known as hunchback or sometimes called roundback. Kyphosis can result from either a degenerative disease, developmental abnormalities, compress fractures, or trauma. The spinal vertebrae get wedged resulting in a curvature causing a bowing of the back.

There are several types of kyphosis. Postural, usually attributed to slouching, which may result in a loss of musculoskeletal integrity, and mostly found in teenagers; congenital, which results from infants whose spinal column did not develop correctly in the womb and only correctable by surgery; nutritional, which results from poor nutrition especially during childhood (rickets, a vitamin D deficiency, is an example); and post-traumatic, which results in untreated or ineffectively treated spinal fractures. Kyphosis is more prone in adolescents due to poor posture than anything else.

Severe cases of kyphosis can cause much pain and discomfort, breathing and digestive difficulties, cardiovascular issues, as well as neurological complications. Such severe cases can only be resolved by spinal fusion surgery. In some cases, kyphosis patients will require a reoperation within a few years of the initial procedure so the long-term effects are unknown.

In Nina's case it is unknown what is the root cause of her kyphosis condition. It appears that correcting posture with some sort of back brace is not an option since Nina most likely would have tried that. Edelman refers to Nina as needing an operation so her condition must be somewhat severe. However, during the film Nina does not appear to be in any pain and goes about her duties as if there was nothing wrong suggesting her kyphosis condition is more of a cosmetic embarrassment and not any physically debilitating condition. Also, it is not clear how Edelman will apply or administer the spore extract to Nina's back. Most likely as a topical rub to get the extract to the spine area and not an injection which would circulate all through the body perhaps affecting and weakening other bones.

#### Another transfusion

Realizing that Latos is trying to get Miliza to become his latest victim Edelman suggests that perhaps another transfusion of his blood into Latos may temporarily stop the blood lust. The theory here is that the natural human antibodies in Edelman's blood will neutralize Latos' parasites thereby negating Latos' need for fresh blood. This is an early example of SF film immunotherapy. Edelman says to Nina, "Prepare for a transfusion", meaning transfuse more of Edelman's blood into Latos. Nina responds, "You can't give another one so soon." (True, unit blood donations require about 6 weeks between donations to allow the body to naturally replenish the donated blood. However, it is unknown exactly how much of Edelman's blood was transfused into Latos. Based on the syringe used, a 10cc volume, the amount transfused appears to be small. Therefore, if the blood volume is low then Edelman could certainly donate another 10cc of blood without waiting.) Understanding the urgency of trying to save Miliza from Latos Edelman gives a transfusion anyway.

#### Latos' confrontation

In a later follow-up doctor – patient meeting, Edelman says to Latos, "I was puzzled by the new antibody...I know now where they came from. They're from my blood. We may be on the verge of an important discovery. To check my theory I'm going to give you another transfusion." The actual transfusion again appears to be 10cc at a time. Nina does the transfusion work. Unfortunately, during the transfusion Latos puts the whammy on Nina who then reverses the blood donation putting 10cc of his own blood into Edelman. Edelman is now infected with and susceptible to the 'Dracula parasite'.

Like many infectious diseases that require some incubation time the parasite acts in a similar manner by slowly taking over Edelman who changes into 'mad scientist' mode, complete with sunken eyes, more whiskers, disheveled hair and eventually loses his reflection in a mirror, suggesting vampirism. Edelman realizes his fate by

saying, "My blood has been contaminated by the blood of Dracula. My soul and mind have been seized by some nameless horror. A lust which changes me into the thing that killed Sigfried tonight...This evil thing must be destroyed."

#### Antibody discovery

During the mid 1940s, when HOD was in production, antibodies were poorly understood proteins that seemingly were able to neutralize some antigens and germs. Assays to identify antibodies at this time were quite primitive, time-consuming, and not especially accurate. Which is all the more remarkable that Edelman was able to identify his own antibodies in Latos' blood. (It wasn't until the late 1960s that antibodies became better characterized and understood.) The identification and use of human antibodies as a plot device, especially during the mid-1940s when the world was still at war, represents one of the more remarkable accurate insights into the future world of biomedicine and immunotherapy. In a remarkable case of life imitating art, the 1972 Nobel Prize in Medicine went to Dr. Gerald M. Edelman (1929-2014) of the Rockefeller Institute for discovering the structure of antibody molecules. As far as I know, the Edelman in HOD is no relation to Nobel Laureate Edelman, though both worked on antibodies.

#### Back to Frankenstein

Now in his mad scientist state brought about by the infection of Dracula's parasites, Edelman returns to the Frankenstein monster and says while adjusting a monster-reviving instrument, "Frankenstein gave you eternal life. Power, that time cannot destroy. The secret of immortality will soon be mine." Edelman then gives the monster a maximum electrical charge, shoots him full of electricity, which gives him enough energy to get off his gurney and eventually destroy Edelman's lab.

#### Summary

In spite of plot holes and inconsistencies this is a scientifically entertaining film. Dr. Edelman is a busy scientist and one of cinema's first to use biotherapy to cure disease and illness. First, he creates an anti-toxin to cure Dracula's curse. Concurrent with this he uses a spore enzyme extract to cure Larry Talbot's lycanthropy. Furthermore, he infuses Frankenstein's monster with a full electrical charge and attempts to repair a hunchback's spine. Edelman can do it all. In the course of all his curing, Edelman did not pause long enough to catch his breath.

For a 1945 film, the hematology and immunology concepts presented are quite satisfying. Now done routinely, the use of the human immune response to manage disease is very much an SF concept for the mid-1940s. And using plant-derived material for biotherapy, also very much an SF concept at the time, is now a scientific reality.

Nina's and Miliza's original work was to take a species of tropical plant and distill an active ingredient that can soften bone and perhaps cure Nina's hunchback. In and of itself an interesting SF concept and first tested on Talbot's skull bone. Since the procedure seemingly worked then perhaps this could be used on other bone

diseases. (How would this treatment have worked on someone like Robert Merrick, the Elephant Man? Would all of his bones soften and not be the problem they were?)

The blood transfusion between Latos and Edelman deserves comment. It is critical that the human blood supply be safe and contamination free. Too many diseases, AIDS being one of them, are transferred from human to human through contaminated blood. This then begs the question of how to protect the blood supply. Constant testing and vigilance are necessary and blood banks throughout the world do this on a daily basis. When new tests are developed that help insure the safety of the blood supply they are quickly implemented into the blood screening protocols. Even just a small amount of blood, a seemingly 10cc volume seen in the film between Latos and Edelman, is more than enough to transfer an infectious agent from human to human. It didn't take long for the Dracula parasite to overtake the will and drive of Edelman.

To me, it's all about the science and the Universal Studios' film, *House of Dracula*, is one of the better films which delivers the goods on all science levels.

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