"The Spark of Life"; popular science of Mrs. Mary Shelley

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Submitted for your approval

"Bring life to the dead." –Dr. Waldman

Mrs. Mary Shelley wrote the book, *Frankenstein*, which was published in the year 1818. Many claim this book to be the first true work of science fiction. Soon we will be celebrating the 200th Anniversary of the creation of Frankenstein so we are fortunate to have such a rich two-century history of this iconic story. And much of this history we tend to take for granted which is why it would be of interest to examine the beginnings of the Frankenstein legend to better understand how it all came to pass. Essentially, what were the inspirations that "sparked" the ideas of Frankenstein in a young Mary Wollstonecraft Godwin (nee Mary Shelley) during the early 19th Century when she wrote her book?

Mention the name, Frankenstein, and all sorts of images come to mind both of the monster and his scientist creator. After all, we have 200 years of history to draw from. Images of Frankenstein are global and can be found on virtually anything and everything. For us Baby Boomers the image most readily seen is of legendary Boris Karloff who defined the screen role in the 1931 Universal film, FRANKENSTEIN. For the scientist role it seems that two images come to mind, one of Colin Clive (Henry Frankenstein in the 1931 Universal film) and the other of Peter Cushing (Victor Frankenstein in the 1957 Hammer Films' version, THE CURSE OF FRANKENSTEIN). In the original book (as well as the Hammer film) the name of the scientist is Victor Frankenstein that was changed to Henry Frankenstein for the Universal films. Both defined in their own way the roles they created and the labors it took to make the creature. However, before all this came to pass it all started with the printed word and parlor room chitchat.

Popular Science

The popular science of the early 21st Century is on DNA and its various mutations. Get the right gene or fix the problem gene and all is good seems to be the popular science mantra of today. On the other side of the coin are those whose mantra is "hands off my DNA" so no matter your position it is all about DNA here in the early 21st Century. About 100 years ago, during the first part of the 20th Century, the new science of endocrinology or hormones had begun so the popular science of the day involved glands and gland extracts. At that time it was glands that could "restore youth" and "bring vigor back to life". And 200 years ago, during the early 19th Century, the new areas of electricity, anatomy, and physiology dominated parlor room and pub discussions. And this is where we begin our story about Mrs. Shelley and the popular science of her day and

how that influenced her creation. (With that in mind, how would it go if her story were written 100 years later during the early 20th Century when the popular science of the day was glands? Furthermore, how would the story go now, 200 years later, in the popular science DNAge?) In an attempt to answer the question, "what inspired Mrs. Shelley's masterpiece?" you will have to continue to read.

We know that books and films mirror and reflect something of the society in which they were made whether they are contemporary, period pieces, or futuristic. In the 21st Century the science in SF films, or more specifically the biology, also mirrors contemporary thinking and, more importantly, the knowledge and understanding available at the time. Each decade of films have brought new knowledge and understanding from the world of science that was reflected in the contemporary setting of production. Since no film existed in Mrs. Shelley's time then different criteria must be used. In the early 19th Century it is the presence and prevalence of books as well as parlor discussions that reflected society at the time. So, what books were available to Mary Shelley and what were most parlor room discussions about? It is also important to know what science, during the early 19th Century, is known to scientists and of this what science is known by the public and in particular Mrs. Shelley. After all, her book, *Frankenstein*, is a work of science fiction so the science available to her is also important in understanding the background that led to the creation of the book.

Mary Shelley began writing Frankenstein mid-June, 1816 so what popular science was known during the early 19th Century is what she knew and what she wrote about. When Mrs. Shelley unleashed *Frankenstein* onto an unsuspecting world with the hidden message of "some things man was meant to leave alone" she brought together the popular science of her day which were alchemy, anatomy, galvanism, and electricity mixed with some body snatching. In her day these topics were new concepts and as such these topics dominated many discussions as pop culture of her time. This has parallels in today's world where the "spark of life", our genes and DNA, today's popular science, mixed with genetic manipulation mirror the early 19th Century's concepts of doing things man were meant to leave alone. After all, 200 years after Mrs. Shelley, here in the early 21st Century, we have the power to play God by making genes, adding genes, mutating genes, and/or subtracting genes. Scientists can now make species faster than God and how blasphemous is that? According to some these are certainly things man were meant to leave alone. However, genetic manipulation ultimately means better health so in this respect we are meant to manipulate our genes to improve our ability to thrive.

Early Education

William Godwin, Mary's famous father (a writer and political activist), held many parlor room gatherings at his house with the intelligencia of the day, including scientists and free thinkers, such as Samuel Taylor Coleridge, Thomas Paine, Humphry Davy, William Wordsworth, and others such as poets Lord Byron and

Percy Bysshe Shelley who discussed the fashionable topics of their day, including the concepts of animal electricity, galvanism, its role in physiology, and the possibility of using it to revive the dead. Mixed in with these topics were discussions on the human soul and how the soul could be in the revived dead. All of this did leave an everlasting impression on young Mary when a scant few years later at villa Deodati on the shores of Lake Geneva in Switzerland she penned *Frankenstein* using many of the concepts she overheard at her famous father's gatherings. Also available to a young Mary were the popular anatomy books at the time that were in her father's library (see below).

During the 18th Century a period called "The Enlightenment" or The Age of Reason occurred in Europe that was a cultural revolution in which there was a separation from the traditions of the Church and science and intellectual free thinking became prevalent. William Godwin was a champion of this discourse and at his house the popular science of the day was openly discussed by the famous people who visited with all the philosophical, religious, and biological implications involved. (At the time Natural Philosophy meant discussions involving the physical sciences and electricity was a part of that.) Mary overheard these and paid attention so these gatherings essentially served as her education. And being around literary giants inspired free thought and delving in the philosophy of the time of where is the soul in those brought back from the dead. Many thought the heart was where the soul was and the work of Humphry Davy (see below) showed that the heart pumped blood so therefore was not the soul. Then what was the soul and how was it transferred? These were important questions for a young Mary to overhear and contemplate.

During Mrs. Shelley's time, making man without God, irrespective of the method, was considered blasphemous principally because no soul was involved. Many such discussions took place at the Godwin house and little Mary took it all in. Essentially, these discussions amongst the intelligencia of the day certainly sparked the creative energy of little Mary and served as a remarkable education for her; that was her classroom. Simply stated, she paid attention to what was said, evaluated the information herself, and created her own theories that were ultimately expressed in her book, *Frankenstein*.

The Creation

In Mrs. Shelley's book the actual creation of the monster was established in a single sentence. From the 1818 first edition, "With an anxiety that almost amounted to agony, I collected the instruments of life around me, that I might infuse a spark of being into the lifeless thing that lay at my feet" (Volume I, Chapter IV, first paragraph of 1818 edition). Since the monster was birthed by a "spark" strongly suggests an electrical theme and therefore implies she knew about the popular science of electricity and galvanism of her time. The new discoveries of anatomy, especially the indication that the heart pumps blood and is not the seat of the soul, brought a new dimension in man's relation to nature and God that Mrs. Shelley incorporated into her book. Lastly, also implied in the

work are elements of alchemy (“the instruments of life”), which are discussed below.

To further explore the co-mixing of ideas that resulted in *Frankenstein* we need to examine each discipline on its own terms during the late 18th and early 19th Century, contemporary with Mrs. Shelley. The three disciplines simply stated are of electricity & galvanism, anatomy & physiology, and the influence of alchemy. Mixed in with all this was a little body snatching too.

Electricity

The history of electricity goes at least back to the Ancient Greeks who observed that when fur is rubbed against amber there was a mutual attraction between the two. By the 1600s the electrostatic generator has been invented, the difference between positive and negative currents was noted, as well as classifying materials as conductors or insulators. Also, during this time the word, “electric” was coined from the Greek word, electron.

In spite of popular belief Benjamin Franklin (1706-1790) did not discover electricity. However, during the 1740s, using ordinary household items, he developed a theory of positive and negative charges for electricity. Famously, he also showed that lightning was an electrical phenomenon. Moreover, he invented the lightning rod and described the concept of an electric battery. All of this was important for the subsequent work that followed a few years later.

The discovery of electrical current depended upon the development of the battery. In 1800 Alessandro Volta (1745-1827) created the first voltaic pile of alternating zinc and copper plates (an early form of the battery) that produced a steady electric current. Volta also showed that linking a positive electric connector with a negative electric connector could drive an electric charge (or voltage) through them and therefore transmit electricity. The word, “volt” is derived from Volta’s last name. At the time the new discipline of electricity was considered “parlor games” in that electricity was used to entertain and show demonstrations without any particular useful applications. Such demonstrations became popular in European society during the early 19th Century. After these early demonstrations electricity was eventually shown to have real power by performing work and running machines.

Science became popularized during the 18th Century due to the explosive growth of knowledge and interest providing lay people an opportunity to become “citizen scientists”. This was the first time real science developed a relationship with the public. A popular science practice by citizen scientists during the late 18th Century was the “electric theater” in which people could use Leyden jars to discharge electricity and experience an electrical thrill via kissing or perhaps via a human hand holding chain. (These electric theaters may be considered the original Exploratoriums that are popular now). Also at the time much (popular) science was presented at aristocratic gatherings so all could share the new

knowledge. It is these gatherings that helped bring science to the lay people. At the time electricity was a wonder and all were amazed at the tricks that could be performed with it. And Mary Shelley participated in these gatherings not only at her father's home but also with her contemporaries like Lord Byron and, of course, Percy Shelley.

Galvanism

Luigi Galvani (1737-1798) discovered bioelectricity, which he named, "animal electricity", by showing that nerve cells use electricity to communicate with muscle cells, what is now understood as the basis of nerve impulses. His original goal was to use electricity to cure paralysis. Galvani showed that by using two different metals connected in series and attached to frog's legs he could get the legs to move by jolting them with a spark from an electrostatic machine. In his experiments he used thousands of frogs (the "martyrs of science") to conclude that there was some fluid (what is now called 'electrolytes') that allowed bodies to restore movement. Galvani used electrical stimulation of frog muscle tissue to seemingly bring dead tissues back to life. This was eventually called, galvanism or "the science of electrifying dead bodies". By applying electricity to frog muscles he was able to show specific movement suggesting some artificial control of life's processes. In this respect Galvani can be considered a real-life Dr. Frankenstein in attempting to restore life to the dead. Later, Volta showed that Galvani's frogs' legs could serve both as a conductor (i.e., electrolyte) and a detector of electricity.

As noted above, Benjamin Franklin discovered the association of lightning to electricity and Alessandro Volta invented the battery (by putting alternating layers of zinc and copper together). And Galvani took this to another level when he used electricity to stimulate movement in frog legs. As a natural progression Galvani also used human cadaver bodies and parts such as limbs and severed heads in his experiments. Upon stimulation by electricity muscles contracted and relaxed causing diverse facial expressions including opening eyes, facial movements, etc. Arms lifted up and legs moved. All of this gave the impression at the time of giving life to dead bodies as well as body parts. The supposition is that if one can make individual body parts move then by stitching together body parts one could make an entire body move. (The problem, of course, is not movement but, rather, *directed and purposeful* movement!)

In one famous experiment Galvani had iron hooks installed on the roof of his house and during one electrical storm was able to transfer the lightning through his wire system to frogs' legs thereby getting them to move (and confirming Ben Franklin's observation that lightning is electricity). As Galvani himself said of the experiment, "contractions not small occurred in all muscles of the limbs". Galvani used electricity via lightning to animate dead tissues, something Mary Shelley must have noted, not to mention the writers at Universal who penned the original 1931 FRANKENSTEIN film script.

Using galvanism to revive the dead was pop culture science during the late 18th-early 19th Century, the time of Mary Shelley's growth from adolescence to early adulthood, and many a public demonstration was performed showing the effectiveness of how this worked. As an adolescent little Mary herself was even taken to such a demonstration by her father so she was certainly aware of this popular science of her day. As Mrs. Shelley herself said later, "Perhaps a corpse would be reanimated; galvanism had given token of such things."

A student of Galvani (and a nephew), Giovanni Aldini (1762-1834) went to London searching for a "perfect body" to use galvanism to bring it back to life. Simply put, to reanimate the dead. At the time it was thought that if one could restart the heart then one could revive the dead. Ultimately, the body selected belonged to one George Foster who donated his dead body to Aldini's efforts. Though Aldini was able to show limited movement it was artificial and not a bringing-back-from-the-dead event. No doubt Mary Shelley heard of these 'philosophical' discussions not only in her father's home but also in her travels and interactions with others. Aldini can also be considered a real-life Dr. Frankenstein, even more so than his famous uncle, in trying to revive the dead.

To further cement the element of galvanism in the popular science of Mrs. Shelley the following passage from the 1818 first edition of *Frankenstein* will be helpful. To destroy the monster Victor Frankenstein says, "extinguish the spark which I so negligently bestowed" (Vol II, Chapter 2, paragraph 8 of 1818 edition), referring to galvanism of the day in that by removing the spark the body parts would no longer move. This is simple logic in that since the body was animated with a spark then the removal of the spark would stop the animation. Such was the popular science at the time that dominated many a parlor room discussion.

To develop this concept a little further there are applications of this in the Universal Studios' Frankenstein film franchise and these pertain to the bolts on the neck of the monster. One bolt is an anode (negative terminal, positive electrode) and the other is a cathode (positive terminal, negative electrode). In electrical current electricity enters via the anode and exits via the cathode and in doing so electricity enters the monster and animates and invigorates him. This would be the "spark of life". To reverse the process ("extinguish the spark which I so negligently bestowed") and destroy the monster, something Dr. Mannering attempts in the film, FRANKENSTEIN MEETS THE WOLF MAN (but could not go through with it; see below), would mean the drawing *off* of electricity thereby removing or reducing the electrical stimulus and ultimately extinguishing the spark. Think of a rechargeable battery in which the charge can be increased or reduced depending upon the flow of electricity and the same would go for the monster in that his electrical energy could be reduced, ala Mannering, or increased to invigorate as seen when lightning strikes the monster in the film, THE GHOST OF FRANKENSTEIN Since the lightning bolt only hits the monster's right neck bolt then this one must be the anode and his left neck bolt is therefore the cathode.

As Mannering reads from Frankenstein's notebook, "Matter ages because it loses energy…this my creation will never perish unless (turns page of notebook) its energies are drained off artificially by changing the poles from plus to minus…energy that cannot be destroyed can be transmitted…adjusting the plus poles to the minus poles will change the energy output of the nervous system." What this means is the reversal of the poles would drain off electricity (i.e., energy) just like draining a battery. In the end, Mannering the scientist could not drain energy from the monster but, rather, succumbed to the urge and restored him to full power. Essentially, this discussion involved Galvanism and using electricity to enhance energy levels and to control body movements. And all of this was inspired by the writings of Mary Shelley who herself was inspired by the popular science of her day.

Anatomy & Physiology

Studies in anatomy date back to primitive man with his cave paintings made during the Ice and Stone Ages. Anatomical studies became more serious with the ancient Egyptians who recorded these in various papyrus documents. During the Reformation the Italians emerged as the anatomical experts creating texts with copious illustrations showing the wonders of the human body.

Considered the father of human anatomy is Andreas Vesalius (1514-1564) whose book, *De Humani Corpus Fabricia* ("On the Fabric of the Human Body"), published in 1543, set the standard on anatomy for the next 250 years. The excellent pictorial anatomy illustrations in this book helped inspire many famous artists from Michelangelo to Rembrandt in their anatomical renderings that showcased the wonders and complexity of the human body that were readily appreciated by the general public. In addition, the superb drawings of anatomy by Leonardo da Vinci also helped to inspire many generations to follow with how accurately he captured the visceral detail. Such artistic anatomical illustrations influenced scientific advancements suggesting that art does influence science. Another example is Bartolommeo Eustachius (1514-1574), an Italian anatomist who published, *Opuscula Anatomica*, in 1564 that focused on kidneys and the vascular system that became a popular anatomy book. Eustachius is considered one of the founders of the science of human anatomy (Eustachian tubes in the ear canal are named in his honor).

The availability of the printing press (in 1450 by Johannes Guttenberg) made anatomy books accessible to the general public that significantly helped spur the interest by making various drawings and images of body parts available. During the 17th and 18th Centuries anatomy flourished and essentially was the most prominent field of biology that was being studied at the time. William Harvey famously showed during the early 17th Century that blood circulates through blood vessels. And no doubt Mary Shelley saw these books on anatomy in her father's library and was aware of their popularity.

In Mary Shelley's time, during the early 19th Century, anatomists and surgeons knew that the heart and brain were important. Anatomist Humphry Davy (1778-1829) showed that the heart pumps blood and is responsible for circulation, quite a remarkable discovery at the time since many thought the heart is where the soul was. Davy was a supporter of the "vital powers" theory that gave man the ability to conquer nature and reanimation and galvanism were a significant part of this. His thoughts were openly discussed at the Godwin home that he frequently visited. And Mary paid attention to what was said.

Mary Shelley knew from the popular talk of her day that bodies were needed and used for the many anatomy demonstrations at the time. From Mrs. Shelley's book, Victor Frankenstein says, "I collected bones from charnel-houses…the dissecting room and the slaughter-house furnished many of my materials", (Vol 1, chapter 3, paragraph 9 of 1818 edition), a quote that strongly suggests she was aware of current events. Those needing cadavers were not particular whom or where they came from, as long as they were fresh (decayed bodies were of little use to the anatomist). Any many of these bodies did indeed come from criminals (the worst of their day) whose bodies were used by anatomists of the time for demonstrations. (The real life use of criminals' body parts being stitched together for galvanism experiments no doubt inspired the idea of using a "criminal" brain in the 1931 film, FRANKENSTEIN.) Also, having a body dissected meant at the time that there would be no corporeal body for any sort of afterlife so even criminals feared being dissected and did their best to argue themselves out of that fate (few succeeded).

Alchemy

Alchemy originated in Egypt. The ancient word for Egypt, Khem, refers to the rich black soil of the Nile area. When Alexander the Great and the Greeks conquered Egypt they blended their culture of earth, air, fire, and water into the sacred science of Egypt (embalming and the afterlife) and the new word, Khemia, was used to describe this new fertile land with the blending of all elements of life. From Khemia we get chemistry. Arabs like to add the prefix "al" to many words and when they conquered Egypt in the 7th Century AD they called the "black land", Al-Khemia, and from that we get the word, alchemy. The Arabs contributed much to the beginnings of alchemy and helped define most of its lore. During the Crusades alchemical lore was introduced to Spain by the Arabian Moors and from there it gradually spread throughout Europe. The defining elements of early alchemy are the creation of the philosopher's stone, the ability to transform metals into gold, and to develop an elixir of life that brings eternal youth. Also mixed in with this were some mythology, magic, and religion. Out of this mix evolved the disciplines of chemistry and medicine.

In the 14th and 15th Centuries some of the Arab alchemy writings were translated into Latin that thereby exposed many Europeans to this discipline making many converts and practitioners. With the influx of European thought alchemists moved away from physics and devoted their efforts on mankind as the

alchemical vessel. This is an important concept that Mrs. Shelley used as a backdrop in her creation and again shows that she used her contemporary general science knowledge including alchemy to help drive the basic plot of *Frankenstein*.

In the book, *Frankenstein*, Mrs. Shelley actually mentions several alchemists by name. Two of the most famous mentioned being Heinrich Cornelius Agrippa (1486-1535) as well as Theophrastus Bombastus von Hohenheim (1493-1541), better known as Paracelsus. Both of these men were key contributors to alchemical lore in Europe and greatly helped to make alchemy the pop culture of the day. The alchemical books they wrote, along with others such as John Dee (1527-1608), were popular and influential books that were much discussed so at the time, though much had been debunked, alchemy was still very much a pop culture phenomena. Paracelsus is especially key in pioneering the use of chemicals and minerals in alchemical medicine. Paracelsus believed that humans must balance minerals in their bodies and some diseases could be remedied or cured with chemicals. From this thinking herbal medicine and plant remedies developed. Furthermore, homunculus development and making various forms of life were at the dawn of medical and pharmaceutical branches. As a result of all these alchemical efforts the workings of the human body were gradually discovered. And the imagination of Mrs. Shelley in developing her plot was at the forefront of all the pop culture thinking of her time by incorporating all that she knew and pushing it into an entirely new direction.

Body Snatching and the Resurrectionists

With the revolution occurring in anatomy more and more cadavers were needed to satisfy the demand for teaching hospitals and medical schools as dissection material. At the time specific “demonstrations” were given on a particular aspect of anatomy and surgery and a fresh corpse was needed each time. With the rise in medical students and the subsequent need for cadavers then the practice of body snatching and even ‘anatomy murder’ became prevalent. Body snatching was the sneaking into graveyards and digging up corpses, the fresher the better, and selling them to teaching hospitals for use in anatomy demonstrations. At the time this method of obtaining bodies was controversial and there were many popular discussions during the early 19th Century about using bodies for anatomy demonstrations. All of this did influence a young Mary.

Those who dug up the bodies and sold them to medical schools for a living were called, Resurrectionists, and they helped to satisfy the demand for bodies. Those in the medical profession who obtained the bodies for demonstrations asked few questions of the Resurrectionists about the ways and means of how they obtained the bodies. Whenever a body was laid to rest the rest period was not long since these body snatchers quickly went to work and obtained as fresh a body as possible. Later, those such as the infamous Burke and Hare, who dug up bodies for the medical profession, began to obtain bodies through murder to help satisfy the demand. (Just so you gentle readers know, the exploits of Burke

and Hare did not begin until the late 1820s, well after Mrs. Shelley penned her novel.)

Volcanic Summer

Not many are aware that the opening sequence in the 1935 film, THE BRIDE OF FRANKENSTEIN, is actually based on a bit of reality. During this film sequence, when a young Mary Shelly (played by Elsa Lanchester) was induced to tell her tale of Henry Frankenstein, a raging storm was brewing outside. The summers on the shores of Lake Geneva were typically calm and mild but not so for the summer of 1816.

It all began with the eruption of the Tambora volcano, located on the island of Soembawa in Indonesia, on April 15th 1815. This particular eruption lasted a week and continued rumbling for 3 months. The Tambora volcano was originally 14,000 feet high and after the eruption the elevation dropped to 9,000 feet (almost a mile decrease in elevation!). As a result about 10,000 people on the island were killed and another 80,000 people would eventually die from starvation and diseases related to the eruption. It has been estimated that Tambora was one of the largest recorded eruptions with estimates of 1.7 million tons of dust put into the air equaling 6 million atomic bombs! Due to the Earth's rotation and high atmospheric weather patterns this volcanic dust reached the Northern Hemisphere during 1816 significantly blocking the sun (and reducing solar output) thereby bringing about what has become known as the "year without a summer". For most of Europe the summer of 1816 consisted of inclement weather, many storms, and unusually overall harsh conditions.

Stitching it all together

The summer of 1816, the 'year without a summer', is when Mrs. Shelley wrote her book. So we can be thankful for a volcanic eruption that lead to bleak summer conditions on the shores of Lake Geneva that helped put Mary in the mood to dream up the saga of Victor Frankenstein and his creation. The exploits of Mary and Percy Bysshe Shelley, Lord Byron, and Dr. Polidori at Villa Deodati in Switzerland during the summer of 1816 have been extensively written about and the unusual summer storms were an excellent source of inspiration for them to tell their "ghost stories".

And all the work with galvanic electricity on animal tissues and the quest to reanimate the dead equally inspired the writings of Mary Shelley. So, during the late 18th and into the early 19th Centuries the popular science of the time was galvanism, alchemy, and the new findings of the anatomists. All of this was on Mary Shelley's mind when, as a teenager, she created *Frankenstein*. The popular science of the time mixed with the results of the inclement weather changes in central Europe from the volcano and the suggestion of writing a ghost story all blended together in Mary's mind and thusly a legend was born. Each of these components was necessary for the final blend and with any of them missing then the result, the book, would most likely not have happened.

To capsulate, Mrs. Shelley took note of the popular science of her day and like a stew, mixed it all together, and created something that, 200 years later, still resonates and dominates many of our thoughts and "parlor" discussions. That spark has never been extinguished. An example of how long the shadow cast by Mrs. Shelley is take note of the Universal Studios' Frankenstein films that are peppered with ideas and concepts touched upon by the popular science in her book, such as birth by electricity, invigorating by lightning, animating body parts, homunculi, and bringing dead tissues to life.

Now, 200 years later in the early 21st Century, artificial life has been created at the cellular level. Dr. Frankenstein's surgeries and procedures are now routine. Stem cells are being driven to morph into organs like a pancreas, heart, and brain and a spark of life is not required for any of this to occur. Even a completely computer generated DNA life form has been created that can self-replicate which would have been inconceivable during Mrs. Shelley's time. So, to blend or stitch it all together popular culture, especially pop science, was a key element of the creation of Frankenstein.

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