chapter one

Bigfoot Science

“Occam's Razor” is a scientific principle used to resolve confusing data and competing interpretations of that data. When several possible explanations might explain some puzzling data, Occam's Razor instructs the scientist to look first and look hardest at the simplest of the several possible explanations.

When trying to resolve the bigfoot phenomenon, several explanations might be used to explain the fact that thousands of eyewitnesses have claimed to see bigfoot-like creatures. The explanations include mass hallucination by eyewitnesses, widespread and sophisticated hoaxing, widespread bald-face lying, and a population of flat-faced bears that run around on two long legs. All of these explanations become more complicated to resolve and more improbable than the much simpler possibility that there is a population of bigfoot animals that have been somehow scientifically overlooked.

If sightings reports are not indications of real creatures, then all of the people who claim them are mistaken, utterly delusional, or lying. If we were dealing with a witness pool in the dozens or hundreds, then one of these three possibilities would seem most likely. But when the pool of witnesses numbers in the thousands or even tens of thousands, then truthfulness becomes the simplest possibility. The other scenarios become absurdly improbable, particularly when the time is taken to thoroughly investigate the individual reports.

The bigfoot phenomenon is not taken seriously by most people because it lacks the endorsement of "science." If such creatures really existed, it is argued, scientists would know it and they would have told us, because it is their job to do so. The general feeling seems to be that scientists who study stuff like bigfoot, whoever they are, would have proven their existence by now.

Who are the bigfoot scientists? Is there even such a thing as bigfoot science? There are anthropologists who study human origins. There are primatologists who study apes, monkeys, and other non-human primates. Then there are cryptozoologists who study the possibilities of unclassified creatures throughout the world. Those who study the bigfoot mystery specifically may be most properly known as hominologists and their area of study, hominology. At least, it is more dignified than "bigfoot science," which is seen by most to be a bit of an oxymoron.

The phrase "bigfoot science" is an example of both an oxymoron and ratiocination. Most people think bigfoots are a myth. To put the word "bigfoot" next to "science" is to create an apparent contradiction. It is an oxymoron, like "plastic glasses," "jumbo shrimp," "old news," and "student teacher." Oxymorons are not the contradictions that they appear to be. I was once a student teacher. There are really big shrimp. Not everything we call a glass is made from glass, and some news is no longer new.

When it comes to bigfoot science, it must be noted first that science is really just a means of systematically verifying carefully constructed questions. Science is OK with, or just indifferent to bigfoot, whether they exist or not. It is scientists (the people) who are generally not OK with bigfoot. Scientists have biases and emotions that the scientific method does not. The interesting paradox is that scientists, who are generally seen as objective and impartial, tend to show the same biases as non-scientific folks when it comes to the thorny question of bigfoot. It is fair to say that most scientists have not informed themselves about the bigfoot subject and the evidence that exists to support it. Yet most people who call themselves scientists will confidently state, from a position of no particular knowledge, it is improbable in the extreme that any such creatures could exist. They are usually responding to a preconceived notion that they have gained from seeing tabloid headlines and silly pictures while standing in line at the grocery store. They reason that no subject that is lampooned so regularly in the tabloid media can have any truth behind it.

Since scientists are people, they are capable of the same human foibles as the rest of us when it comes to consideration of the sasquatch. Their considered opinions sometimes contain the same faulty logic and bias as the opinions offered by the general public: there cannot be just one of anything, we would have found bones by

now and, none of the people who claim to have seen "it" are credible. If bigfoot were real, we would know.

Truth be told, scientists in general have not looked into the bigfoot phenomenon because they cannot afford to ruin their careers. To seriously investigate the matter would jeopardize their scientific reputation in the eyes of their peers. Even in the impartial world of science, bigfoot is a pariah that might taint the reputation of any scientist who took on a professional or intellectual interest in the matter.

Science does not worry about its reputation. Scientists care very much about their reputation. Science does not care how it gets paid. Scientists do. And no subject is more likely to invite ridicule from scientific peers and academic colleagues than bigfoot. No subject heaps more embarrassment and jeopardizes funding more completely than an affiliation with bigfoot research. There may be other subjects that are just as bad (Loch Ness Monster and UFOs come to mind), but nothing could be worse. Scientific pursuit of the bigfoot phenomenon is a fast track to professional suicide for aspiring and established scientists alike.

Dr. Grover Krantz, who sadly died in February of 2002, was well aware of the professional penalty for taking bigfoots seriously. He was a career anthropologist and the first scientist to give serious academic consideration to the bigfoot mystery. His willingness to weigh the evidence brought him personal ridicule and loss of promotion at Washington State University. He never discussed it, but he was ostracized by his peers, who seldom bothered to read his published work. Like Galileo, Grover Krantz, Ph.D. brought ratiocination, or carefully reasoned thought, to a subject that was previously dominated by unscientific dogma. And like Galileo, Dr. Krantz's contribution to science was not fully recognized at the time of this death.

Krantz was the first academic to apply ratiocination to the bigfoot enigma. Krantz pioneered the careful study of footprint casts, fossil evidence, and early photographic evidence. He concluded that many track casts are not fakes, and that some recent footprint evidence was a suitable match for fossil jaw and teeth evidence that was 300,000 years old. Krantz concluded that much of the modern bigfoot track evidence was too detailed and anatomically correct to have been faked. Instead, it pointed to relict populations of *Gigantopithecus* blackii, which is not as extinct as it was thought to be.

I met Dr. Krantz a year before he died and I regret that I never

thanked him for changing my opinion of bigfoot science. I suppose I also owed him an apology, because I probably ridiculed his suggestion that bigfoots existed before I ever actually listened to his informed and precise articulation of the evidence.

In fact, I once used the bigfoot subject in the middle school science classes I teach as an example of the misapplication of science. “Pseudoscience” is the condescending term used by mainstream science to denigrate subject matter that besmirches the good name of science. “Creation science” is another example of a subject that does not qualify as genuine science as much as a misapplication of science. As a science teacher I presented an annual lesson to the eighth graders on how pseudoscience is used to earn serious consideration for flaky pursuits like looking for Atlantis, Noah's Ark, and Bigfoot.

Students always stay more interested in a lesson that is peppered with humor, especially when addressing something as dry as the scientific method. That fact helped elevate the bigfoot subject above the other examples of pseudoscience. Not only does the bigfoot subject possess vast potential for humor, but there was no danger of stepping on the toes of students or parents who might object to making light of a subject they felt strongly about. Bigfoot has no anti-defamation league and bigfoot is about as safe a subject for classroom humor as a teacher could possibly find. So, off I went into my lesson, complete with jokes and anecdotes and logic:

- You can't have just one of a creature.
- It takes two to reproduce and still more to create a viable gene pool.
- All it takes is plywood and a jigsaw to create big, barefoot tracks.
- Ape suits rent for forty bucks. Hoaxers have come forward and admitted their pranks.

I was pretty pleased with myself. The kids were interested and they got the message that I wanted them to get: Bigfoot was pseudoscience.

The third year that I ran this lesson I got my hands on a TV documentary about the Bigfoot Phenomenon. The show included a segment with Dr. Grover Krantz. He discussed track anatomy, and fossil jaws from Viet Nam and teeth from China. He attributed these fossil

remains to the supposedly extinct primate species known as *Gigantopithecus*.

Dr. Krantz spoke with a scientific precision and an academic background in anthropology. He explained the details of his track casts. A track cast is made by filling the impressions in the ground made by animal footprints with plaster, or plaster like substances such as dental stone or hydrocal-30, both of which are more expensive than plaster but are harder once dry. Krantz explained how casts of bigfoot tracks suggested a foot anatomy that made sense for an animal that was much heavier than we were. A larger footprint from a taller and heavier animal would have a different metatarsal hinge or “ball” of the foot, maybe even two "balls" in the foot just behind the toes. Sure enough, the track cast he had seemed to show two balls in the foot. They also seemed to show a foot that had an ankle that was not in a vertical line with the heel as in our human foot. A much heavier creature would have an ankle that was closer to the center of the foot. The track casts he held seemed to show evidence that they were made by a foot whose ankle was more distant from, and forward of the heel. Krantz also spoke of other characteristics of the track casts that he used to determine their authenticity, though he didn't reveal them in the taped interview.

Years later, I crossed paths with Krantz in January of 2001 during a conference on the Skookum Cast (Chapter 6). I asked him about the characteristics of track casts which he used to separate the genuine ones from the fakes. It turns out that one was the "dermal ridges" or fingerprint-like lines that swirl around the hands and feet of all primates, but which are found only on primates. If the earth or mud that contains a bigfoot track is fine enough, the fingerprint-like dermal ridges will be faithfully preserved in the plaster cast. The dermal ridges will not make tightly curving swirls such as the ones seen on our fingerprints. On tracks that appear to be genuine, the dermal ridges can be expected to make coarse, widely curving patterns that encircle the margins of the entire foot. Then there are the “Krantz Three,” which Joe Beelart and Larry Lund found mention of in an old letter that Krantz wrote to Rene Dahinden: A two-section foot, square toes, and a straight line across toe ends. Personally, I do not feel that these three traits are common to all authentic sasquatch tracks but they are interesting observations to bear in mind when inspecting track casts.

Another unique characteristic is even more difficult to distinguish without a hand lens. Tiny dots in the plaster are indication of perspiration pores on the skin of the foot. These skin pores allow the foot to breathe and perspire. These skin pores are found only on primates such as apes, monkeys, humans, and bigfoots. They are also very tough, maybe even impossible, to fake in a convincing manner.

Krantz's contribution to the bigfoot documentary certainly gave me pause. For the first time, I was seriously considering the possibility that such creatures really might exist. His reasoning was sound and his logic was persuasively simple: An animal that is certain to exist in the recent fossil record and thought to be extinct, may not be extinct at all. It would not be the first time that a supposedly extinct animal was still around. The coelacanth, a fossil fish from Mesozoic time has been caught by fishermen in two oceans while scientists assumed the creature to be long gone.

That was the last time I presented the bigfoot lesson as pseudoscience. I wasn't yet to the point of being convinced that the creatures still existed but I was at the point of re-evaluating my dogma that bigfoot was the stuff of pseudoscience. Krantz had given the subject a certain credibility that I had not previously been aware of. I was not about to abandon bigfoot as a science lesson, but it was a turning point. In future years I used the bigfoot lesson to emphasize scientific mysteries and the scientific method, but not pseudoscience. I featured the bigfoot phenomenon as an example of those things that science has yet to get a handle on; things that seem to have an intriguingly strong possibility about them despite the fact that absolutely nothing about the matter has been scientifically nailed down. That cherished institution called science that we rely on so heavily to keep us informed about our world still had some work to do.

On the one hand it could be argued that scientists already have proven bigfoots exist. On the other hand it could also be said that they have not come close, and they possibly never will. It is this kind of contradiction that seems to define the bigfoot phenomenon over and over again. These contradictions also make the subject fascinating to those with the interest in considering the pros and cons of a fairly complicated issue.

To take the first position, the work of career anthropologist Grover Krantz has brought to the surface aspects of track casts and the fossil record that are difficult and maybe impossible to completely refute.

His lines of evidence are pretty good, but not good enough to satisfy most zoologists that a primate species that is larger than Homo sapiens (humans) exists in North America, or anywhere else. Part of the problem is that such a claim is so extraordinary.

"Extraordinary claims require extraordinary evidence," was the phrase invoked by astronomer Carl Sagan when appraising the quality of the best evidence for UFOs. The same can be said for why the physical evidence and thousands of eyewitness accounts are not seen as sufficient to prove that sasquatches roam the North American forests.

Science, per se, is not where the roadblock lays, for science is really a process, not an institution. The scientific process, or the scientific method, is just a way of attacking a question by experimentation so that an irrefutable answer is achieved.

The Six Steps of the Scientific Method

1. Identify specific questions related to the problem at hand.
2. Propose an answer to one of these questions in the form of an educated guess.
3. Formulate a hypothesis; stating the educated guess in such a way that it can be tested.
4. Predict the outcome of the test in the event that the hypothesis is
5. correct.
6. Test the hypothesis by analysis or experimentation to see if the hypothesis is correct.
7. Reject or revise the hypothesis if the experiment does not support it.

Every experiment that is truly scientific does not require a design that precisely adheres to these six steps. It may incorporate these steps into a single avenue of inquiry, but the principles implied by these steps are always identifiable. The most important aspect of a scientific inquiry may be that only one variable may be tested at a time, and all other variables that might affect the outcome of the experiment must somehow be "controlled." Failure to truly isolate the variable being tested from all other variables may be the biggest difficulty when designing a scientific inquiry.

Experiments with animals are more challenging because it is so

difficult to control the variables which include health, disposition, and genetic variation. These variables are factored out by employing very large populations of experimental subjects. This enables the researcher to reduce the influence of individual differences on the outcome of the experiment. Humans are even more difficult to experiment with since there are far more environmental influences that must be accommodated. The subjects cannot be kept in cages that are closely supervised. Genetic variation and the psychological mindset of humans make for even greater variability. Again, statistics is often the answer to these problems and experiments must sample larger populations in order for the statistics to generate reliable answers.

It's a wonder science is ever able to prove anything when all of the possible variables are taken into account. Truth be told, science cannot really prove things very often. Experiments generally produce evidence, but seldom, if ever, do they generate proof. Proof is a very elusive concept in science and it may only come when an experiment is successfully repeated many times by different researchers, using the identical methodology, and yielding identical results. This important hurdle, known as “replication,” generally takes many years and many researchers to successfully accomplish. Most experiments with interesting implications get publicized well before this essential hurdle has been cleared, so the public is often misled as to the reliability of a scientific result when it is based on the conclusions of a single experiment, no matter how well the experiment was designed and conducted.

Everyone likes to be proven right and scientists are no exception, but an experiment that invalidates a hypothesis is hardly unsuccessful. In fact, good scientists actively pursue evidence that refutes their own hypothesis. One way to do this is by constructing a null hypothesis, as well as a working hypothesis, when designing the investigation. The null hypothesis is the opposite of the hypothesis. It is constructed so that if it is found to be true, the opposing hypothesis must be false. This approach encourages the scientist to avoid favoring one hypothesis when evaluating the results of an experiment. This is particularly necessary when the results being gathered are not completely objective.

And if the general population has trouble making the distinction between a hypothesis and a theory, then the statistical construct known as the "null hypothesis" is even more hopeless to understand.

A null hypothesis is a carefully worded statement that represents the diametric opposite of an experimental hypothesis. A null hypothesis might be developed so that it can be validated or refuted with statistics more easily than the hypothesis itself. But to refute the null hypothesis is to confirm the hypothesis and vice versa. Disproving the null hypothesis is one path to confirming the hypothesis of an experiment.

The null hypothesis helps to underscore in the mind of the researcher the need to keep an impartial mindset when analyzing experimental results. Veteran researchers can fall victim to the error of being overly committed to confirmation of the experimental hypothesis. One must be willing to discard the hypothesis when the data invalidates it. Lacking the data to invalidate the null hypothesis is often the reason why a hypothesis must be rejected.

Conducting a scientific investigation that adheres to these stringent standards may seem like a rigid and uncreative process. Once the experiment is properly designed, perhaps the execution of the research is tedious, rigorous, and conventional. But one aspect of scientific inquiry still leaves room for enormously creative and unconventional thinking. The most creative aspect of the scientific process is the development of the experimental hypothesis and the means to test it.

This is pretty good news for an unconventional soul who might wish to conduct a scientific inquiry of the bigfoot phenomenon. The evidence is much better than most people realize, although it is not good enough to seal the deal. Despite the fact that science is not impressed with the quality of bigfoot evidence collected to date, a person who has taken a careful look at it and who is willing to develop a hunch on that basis might easily come to the conclusion that some serious experimentation is warranted.

At present, the available evidence that supports the hypothesis that bigfoots exist is not persuasive. It is not as weak as most people believe it is, but it is definitely not persuasive either. There are many eyewitness accounts, which are known in scientific circles as “anecdotal data.” Of all the types of data that are considered in science, anecdotal data is considered the most unreliable kind of data, and may not even be worthy of the term “data” at all. Such data might be more properly described as “stories.” They are utterly unverifiable, subjective, and therefore prone to inaccuracy for many reasons, despite their

surprising consistency. There are thousands of bigfoot sightings that originate from reputable and careful observers. If they were witnesses to a crime instead of bigfoot activity, such testimony would be admissible in a court of law, even when the defendant's life hangs in the balance. Yet, such accounts are utterly inadmissible when science sits in judgment. In fact, a case has been made that there is so much secondary or anecdotal bigfoot evidence that if a bigfoot were being tried for a capital crime, he would get the electric chair.

Yes, there is a lot of evidence that bigfoots exist. More than most people realize, though most of it is anecdotal. Someone claims to have seen something, but they have nothing tangible to back up their story. Science works differently than law, and science has no use for unsubstantiated testimony of such extraordinary events.

Of all the evidence that is not anecdotal, footprint evidence may be the best of all. Footprints are the namesake of these creatures in the US, but the plaster castings made from them are of debatable scientific value. “Track cast” is the proper term for plaster forms made from the footprint impressions. The evidentiary value of track casts, as with most bigfoot evidence, is better than most people realize, despite the fact that they are not taken seriously by most scientists. They are seen as easy to fake and since acknowledged footprint hoaxes have occurred, the whole line of evidence has become unfairly tainted. This has effectively overshadowed the important but subtle feature found on genuine track casts.

In the late fifties, track casts were the first evidence presented to the media that supported the bigfoot hypothesis. The general public assumes that such evidence was hoaxed and while it is indeed easy to cut out a piece of plywood into the shape of a foot and leave foot-shaped impressions in the ground for folks to find, it is not a simple matter at all to create footprints that contain the details that would fool an experienced eye. Footprint faking may occur but it does not account for most of the footprint evidence that exists. Faked footprints are, as it turns out, quite easy to identify.

Most sasquatch footprints are found in such remote places and under such accidental circumstances that hoaxing becomes very unlikely. A string of dozens or hundreds of tracks, with enormous strides between them (say 46 to 54 inches apart), found in a remote area, and in deep snow would require a huge investment of time and expense to fake, all with no assurance whatsoever that the phony

tracks would be found before weather forces swept them away. I have seen such “track finds” in the Table Rock Wilderness in Oregon. Hunters, cross-country skiers, and other chance visitors to remote places find them occasionally. Tracks are sometimes seen nearer to farms and ranches in rural locations.

Further, track finds in remote places sometimes suggest complex creature behaviors. Researchers Joe Beelart and Cliff Olson have found hundreds of tracks in the snow on Whalehead Ridge above the Fish Creek drainage. The configuration of tracks suggests that the creature approached a panoramic vantage point where it stood and looked toward the distant lights of Portland, Oregon. Tracks found by Joe near Indian Henry seem to suggest a larger creature and a juvenile stopping by a road and checking for traffic before crossing the road.

Track finds seldom get publicity these days. Recently I received photographs of tracks in the snow that were found deep in the Ruckel Creek drainage near Cascade Locks, Oregon. They were sent to me by Fred Bauer, another reliable field man. They appeared to be authentic, but as is the case with virtually all track finds, the evidence never got publicized.

One problem with footprints is that they are generally assumed to be the product of hoaxes staged for the sake of publicity or practical joking. This is probably a bad assumption. The fact that they are obliterated by weather so quickly makes discovery, much less publicity of someone's carefully crafted fakes highly unlikely. In ten years of following up on reports, I have seen several sets of probable sasquatch footprints that looked quite authentic. They never received publicity, so if they were planted as a joke, someone was disappointed. Tracks are usually too indistinct to justify casting in plaster, and are therefore seldom saved. Photos are good only for making comparisons but do nothing to verify the authenticity of set of tracks.

Among bigfoot researchers, the biggest question may be why tracks are not found more often. Track finds are uncommon even in areas where repeated sightings occur. One reason why tracks are so rare is well understood only by those who have looked for them. Most folks assume that the woods are brimming with animal tracks when the fact is that forested areas have very few patches of bare earth where good tracks might be found. Tracks left in leaf litter, fallen twigs, and the low plants that cover most of the forest floor are not

only vague and indistinct, but also a complete waste of time to try to cast in plaster.

Tracks in snow are very tricky to cast and attempts usually fail. They generally yield little or no detail when they are successfully cast. A wax in aerosol form, known as track wax, must first be sprayed into a snow track. Several thin layers are applied and when that is dry, the track can be cast with plaster. Plaster does not dry. It cures. Plaster curing is an exothermic reaction, meaning excess heat is generated in the curing process. Without a thick layer of track wax to hold the shape of the track, the snow would melt before the plaster was hardened, and the track would be misshapen. Plaster takes a long time to cure in the snow, and most try to remove the cast before it is sufficiently cured. The track cast crumbles and the effort is wasted. It is best to dig out a track and lift it from beneath, but patience is more than a virtue when casting tracks, it is a necessity.

Trails are too compacted to yield any wildlife tracks, save for the sharp edged hoof prints of deer or elk. Even then, it is rare that a continuous set of tracks is found. Creek beds and riverbanks seem to offer some of the best places to find any kind of wildlife footprints that are worthy of casting. These places frequently contain finely textured soils and the periods of high water keep the ground relatively free of plants and leaf litter. Road cuts, landslides, and other disturbed areas are areas of promise for finding footprints. But the tracks of bear, big cats, and other majestic wildlife are so seldom seen in these places that it is clear to experienced trackers that such noble animals likely avoid leaving obvious tracks.

Bear researchers generally acknowledge that bear are clever enough to avoid obvious tracks that reveal not just the bear's presence, but their direction of travel, numbers, overall condition, and more. Grizzly bears and wolves have recently reestablished themselves in states like Idaho and Colorado but their presence and their numbers are a matter of some dispute. It is clear to experienced trackers like Doug Peacock that the new arrivals have learned that their chances of survival are enhanced by keeping their whereabouts concealed to a greater degree than they ever did before. They operate exclusively at night, they do not venture far from their hideouts, and they avoid leaving tracks that reveal their whereabouts and travel routes. It has become clear to veteran bigfoot researchers that the same is true for bigfoots. If bears are clever enough to conceal their whereabouts by

taking care not to leave obvious tracks, the same ought to be true for still smarter creatures such as bigfoots.

In light of the behaviors of other savvy forest dwellers, it should be more understandable that a creature as impressive as a bigfoot could exist but leave few tracks, and it may be a wonder that we find as many tracks as we do. At least it should be clearer why good footprints are rare, and highly detailed track casts are then rarer still.

When good track casts do surface, it is easy to separate the hoaxes from the real ones. Thanks to the work of Grover Krantz and others, the details of track casts have been studied to the point where it is no longer difficult to separate genuine track casts from bogus ones. Some of the most recent contributions to the study of bigfoot track casts have been made by a fingerprint expert from Texas. James Chilcutt is one of the leading experts on fingerprint analysis in the world today. His expertise is, of course, used by law enforcement agencies but he has recently been provided with track casts to analyze from the collection of Dr. Jeff Meldrum, a biologist from Idaho State University who is the most academically credentialed of current bigfoot researchers.

Examining Meldrum's collection of track casts, Chilcutt has found dermatoglyphs (dermal ridges and skin pores) that are distinct from all other primates, including humans. Not all track casts are taken from soil or mud that is fine enough to preserve these details, in fact very few are. But when tracks are found and cast that show fine detail, Chilcutt has found that the dermatoglyphs are so unique and so detailed that it seems impossible to fake them. The dermal ridges are too widely spaced to be human and also too fine and too consistent to be faked. The dermal ridges tend to encircle the margins of the foot in much wider, coarser patterns of ridges than would be found on human fingers or feet. No other primate foot or hand shows this same pattern and only primates have dermal ridges on the hands and feet.

Footprint evidence is now indisputable in the view of at least some of the scientists who have bothered to study the evidence carefully. Jimmy Chilcutt, for one, has publicly staked his reputation on the fact that the track casts he has examined point to the existence of an unknown primate. Dr. Meldrum has made it his goal to introduce this incontrovertible evidence into scientific, peer-reviewed journals. This is an important step in the process of gaining credibility for any new scientific accomplishment.

If Chilcutt is the premiere fingerprint analyst, Dr. Henner Fahrenbach may be the premier opinion on the analysis of possible sasquatch hair. Folks who find some suspicious hair in connection with a bigfoot sighting will find through most bigfoot websites that Fahrenbach is the best bet for identification of the unknown hairs, no matter what the hair's origin. Fahrenbach keeps an extensive reference collection of mammalian hair on hand, and Fahrenbach knows hair well enough that he can easily separate the possible sasquatch hair from the unlikely ones. Unfortunately, as with science in general, there is always a frustrating element of uncertainty.

The last time I asked him, Dr. Fahrenbach told me he had acquired fifteen separate samples from four states that he considered to be good candidates for genuine sasquatch hair. By now, I am sure he has more. All had the same visual characteristics, or morphology, under 1000x magnification, though they differed in length and color. All of these 15 hairs were found as single hairs or in very small batches. This is consistent with how primate hairs are replaced. Big swatches of hair invariably are from bears or other animals. The hair samples that Fahrenbach considers genuine came from oddly twisted trees, nesting sites, foot and body prints, and trees at which a sasquatch had been seen to be leaning against.

The possible bigfoot hair Fahrenbach has acquired range from 4 inches to 15 inches, from root to tip. Interestingly, the tip is worn, rounded, or displaying the familiar human condition known as "split ends." The hair root, or follicle, is generally small, also like a human one.

Fahrenbach's measurement of hair diameter ranges from about 45 microns to 85 microns. This makes the suspect hairs thicker than the very fine hairs that comprise the undercoat of most mammals. Undercoat hairs can be identified not only by their very small diameters, but also by the central hollow core, or medulla, which in the case of undercoat hairs, looks more like a string of pearls than the continuous hollow shaft that comprises the medulla of most other hair. Hair over 100µm is considered to be other species though Dr. Fahrenbach acknowledges that in humans, hair diameter varies, depending on what part of the body the hair came from.

Perhaps the most important criterion of all that visually distinguished suspected sasquatch hairs from all others is the fact that the medulla is almost totally absent. In a few hairs he sees some short segments of fragmentary medulla, which is typical of human hair as well. Bovine (cow) hair can sometimes lack a medulla, but cow hair shows coarse pigmentation granules that are arranged like stacks of Lifesaver candies around the periphery of the hair shaft. Black bovine hair is opaque, which has not been seen in possible sasquatch hairs. Regardless of how they look to the eye, bigfoot hairs always show a reddish-brown appearance under high-power magnification.

An interesting thing about the lack of medulla is that this condition also is seen in some blonde human hair. And without a medulla, neither blonde human hair, nor sasquatch hair yields any useable DNA for analysis.

With all the attention that DNA gets in crime scene investigation, it generally surprises folks to hear that hair does not generate complete sequences of DNA. It may seem to the bigfoot skeptic as a bit too convenient that the supposed bigfoot hairs do not generate DNA, and that they bear a striking similarity to human hairs. When trying to distinguish sasquatch hair from human hair, Fahrenbach has found these differences:

1. Human hair of a 4" length always has a cut end unless it originates from the head of an infant who has not yet had a first haircut. The possible sasquatch hair always has native terminations (uncut ends that are worn, rounded, or split.)

2. Bigfoot hair, whether a straight or wavy shaft, has the same round to oval cross-section for its entire length, and has no color banding. Shorter hairs are likely to have some taper toward the tip.

3. Color of suspected sasquatch hair, when viewed under the microscope, always includes a red tinge plus a variable amount of very fine pigmentation (melanin) granules. No matter whether the hair looks black, brown or red to the naked eye, it shows the reddish tinge under high magnification.

The most curious item of all may be the degree to which sasquatch hair resembles human hairs, on both a macroscopic and a microscopic level. Except for the reddish tinge and no sign of ever having been cut, the sasquatch hairs have the same diameters and the same end features like split ends. On a microscopic level, the

cuticle, which is not even discernible using a good light microscope but which is very discernible using a scanning electron microscope, is identical to human cuticles. And at a molecular level, it appears that DNA analysis is futile, since the mtDNA (mitochondrial DNA) appears too fragmented to allow for sequencing, as is the case in blonde human hairs.

Naturally, a skeptic would argue that this suggests that human hairs are being collected in the field and being labeled as sasquatch hairs in the laboratory. Knowing some of the sources of Fahrenbach's hair samples as I do, I also know that there is more to it than that. Even though the hair evidence must be considered circumstantial, the circumstances surrounding the collection of the hairs in Fahrenbach's collection are generally quite impressive. Usually there was an eyeball sighting of one of these creatures interacting with the tree or fence that later yielded the suspected hair. Dr. Fahrenbach is a very thorough researcher and his documentation of the sources of the hair is quite good.

Fahrenbach own words serve to summarize the situation nicely:

> To help with field identification, look for the following: The hair has no medulla; it seems to have always a reddish cast under the microscope, even if it looks very dark in the hand; its contained pigment is very fine grained; its diameter falls in the range of 50-90 microns; it is essentially indistinguishable from human hair (however, I have 15 separate samples with these characteristics, a quantity unlikely to have been collected by pure chance from human sources). A fat cellular medulla with blocky cells is most likely bear. Ungulate have hair that looks like Styrofoam. Rodent hairs are very fine and have a bead-like medulla. Bovine hair can be confusing as it sometimes has no medulla, but it has coarse pigment in lozenge-shaped masses in the cortex. Forensic hair analysis is always based on A/B comparison, which is something we cannot do for obvious reasons. But I am trying to get close by the statistics inherent in the collection of an increasingly sizable set of hair samples, whose congruity becomes less likely to be due to chance.

The possibility of DNA extraction from hair is something that most

people expect to yield the definitive evidence if bigfoots really exist. On the matter of DNA, Dr. Fahrenbach comments,

> “DNA extracted from hair shaft or roots (hair demonstrably fresh) was too fragmented to permit gene sequencing. That characteristic is sometimes found in human hair that lacks the medulla (as does sasquatch hair - at least what I am willing to identify as such). I am concentrating now on blood or tissue, as the hair holds no promise. Feces do so even less, since the DNA collecting has to be done while they are practically steaming fresh and it is improbable in the extreme that anybody with the fecal DNA expertise would stumble onto a fresh sasquatch turd! By the way, contrary to popular opinion, I have not encountered any deliberate effort to produce a hoax, even with the much decried case of hair from Paul Freeman, whose fiber sample was pronounced to be "unusual" hair by a prominent cosmetics lab! The same man-made fibers have been found elsewhere in the mountains by others and may be an environmental contaminant.”
>
> -Dr. W. H. Fahrenbach

The sensitivity of DNA detection has tremendously improved lately and just as important, the experience and skill of the people who do this work has also improved tremendously. Consequently, it is fairly easy to rule out familiar animals when analyzing the DNA contained in a tuft of hair or a spot of blood. Fresh samples do work much better than the old ones but the levels of detection sensitivity have improved so much lately that the difference is not as important as it used to be.

The actual test is not too tough to understand. If the hair sample includes a root cell or follicle, as well as the hair shaft, then it gets incubated for a few hours in a digesting solution. The DNA is then extracted and the target region is amplified. If the amplification shows that all the necessary pieces are present, then the DNA can be sequenced directly and then compared to known DNA from humans, bears, cows, etc. If all the pieces are not present in sufficient quantity, then the amplified DNA must be cloned in order to produce enough DNA to sequence. Without a follicle at the base of

the hair, the quality of the DNA is greatly reduced and usually consists of smaller, deteriorated fragments. Mitochondrial marker genes can be used to clone the fragmented DNA, a process that is much more involved.

The reader may wonder why DNA analysis is so useful in solving crimes and still be of such limited value in proving the existence of undocumented animal species. The biggest difference is that when looking for evidence of unproved animals like bigfoots, reference samples of bigfoot DNA are not available for comparison purposes. Assigning unknown DNA to a specific animal species relies on making a match against reference DNA that is known to originate from the same species. Without a reference sample of sasquatch DNA, the best result that can possibly come from an analysis of suspected sasquatch DNA is to find that the unknown DNA does not match the DNA of any of the known DNA samples in the reference collection.

One lab may routinely work with bear DNA, in which case they would have a good handle on the polymorphisms on a specific gene that are used to identify (or rule out) bear DNA. Another lab may do work with baboons, monkeys, or other primates, in which case they would have the markers that are used to identify DNA that is of primate origin. Beyond such general determinations, more specific matches are uncertain without comparison DNA from the same species. One disappointing reality is that even when making comparisons to DNA that is known to originate from the same species, there is never a 100 percent match. Every individual's DNA is, of course, a little different from anyone else's, with the obvious exception of clones or identical twins. A DNA match of about 78 percent is typical for human DNA comparisons.

In criminal investigations, DNA identification relies on collecting a DNA sample from the suspect and using it to match against DNA collected at the crime scene. Only then can a 100 percent match be made, and even then the match is only done on a portion of the very long, chain like molecule that is deoxyribonucleic acid, or DNA. Most of this very long chain has not yet been mapped in humans. Select portions of the molecule have been thoroughly mapped as a part of the “Human Genome Project” but we are still many years away from complete mapping of these very large molecules. Currently, about thirty percent of the human DNA molecule is mapped and obviously much more time and trouble has been invested in mapping the human genome than any other species. How can we ever hope to thoroughly map even a small portion of an undocumented species with miniscule amounts of DNA available for analysis, and much of it suspect for one reason or another? However, Dr. Fahrenbach informs me that he is not utterly pessimistic about the chances of isolating sasquatch DNA. He writes:

> “Certain sequences of specific mitochondrial genes are diagnostic for the group of mammals your are dealing with (bigfoots) and others would tell how far such a primate would be removed from man in terms of branching off from a common ancestor. If I had some tissue or a bit of skin, we could get pretty close.”

At this point, Fahrenbach considers DNA work on sasquatch hairs to be, “interesting circumstantial evidence that is not yielding to DNA analysis, despite intensive tries by two laboratories (Ohio State University and Stanford University), including an experienced molecular phylogeneticist who worked, i.a., on chimp hair from nests to determine blood relationships.”

So what was the specific result of the two intensive tries? Naturally no match with DNA of known species, but even if the DNA was from a known species, there would not be a 100 percent match for reasons explained above. More interestingly, there was a match in the 30 percent range with human DNA. While this may be an intriguing result, it is not so conclusive as to "prove" anything. Then there will always be those who allege that the sample was somehow contaminated with tissue from the handler of the material and so the human-like percentage of the result is suspect. Remember your scientific method. Only by replicating the results on multiple future DNA analyses can such ambiguous results be considered reliable. But what could be more unsatisfying than an elaborate and expensive DNA work-up that produced a result like “30 percent known DNA of possible primate origin, 70 percent unmatched DNA.” Obviously, this is not the definitive evidence we seek.

It is safe to say that trying to prove the existence of the sasquatch with DNA evidence, like much of bigfoot research in general, is a bit of a “Catch 22”: In order to prove that DNA is from a bigfoot, you first must have some bigfoot DNA. Hair is the most likely source of

possible bigfoot DNA but hair produces some of the most deteriorated and least useful DNA fragments.

If DNA does not hold great promise for establishing the existence of sasquatches, and if we stubbornly accept that the thousands of eyewitness cannot all be wrong, what remains as a source of evidence that science will accept? Photographic evidence is being vigorously pursued but it does not take very many paragraphs to explain why no photograph is sufficiently reliable, particularly in this day of digitized images and computerized photographic manipulations. While film and video have the same inherent problems, video images may hold some promise, but only if the images are close up and of a longer time duration than the current standard-bearer of sasquatch imagery, which is the Patterson-Gimlin footage.

Filmed in October, 1967, in the northwest corner of California, this short clip of home movie film stands up to serious forensic scrutiny. Attempts to recreate the scene using modern costuming technology fall woefully short of successfully reproducing the anatomical detail such as hand flexion, muscle movement, joint movement, and more. But for all its merit, the Patterson/Gimlin footage is too short and the image is too tiny to be definitive, though it is still the best footage that exists. So, someone who wishes to push the envelope of photographic evidence must gather imagery that is closer, more detailed, and longer. It may still fall short of incontrovertible proof, but it will be a huge step in the right direction. So far, this has not happened. Many have tried to surreptitiously photograph these creatures including myself, always with the same result: the creatures have no inclination whatsoever to cooperate with that agenda. It is my guess that we are hurrying the process too greatly, and defeating ourselves by doing so.

To review, the existing types of evidence that support the bigfoot hypothesis are photographic evidence, casts of body impressions (footprints, handprints, or partial body prints), spoor (hair samples, feces, etc), and sighting reports. Sighting reports will never be material evidence, but properly investigated sighting reports can teach us so much about the creature's appearance and behavior that the next chapter will cover this kind of evidence in greater detail. Photographic evidence exists but it, too, will always be suspect unless the quality of the photographic evidence greatly improves in the future. An extended piece of close range video would be needed to

satisfy the expectations of skeptical scientists. Someday this may happen, but I'm not holding my breath.

The surprise to most people is that footprint casts turn out to be more compelling evidence than hair samples. It may seem odd that an actual piece of one of these creatures, even if it is only a piece of discarded hair, is less important as evidence than a plaster cast of a footprint, a hand print, or another part of the bigfoot anatomy. But plaster casts provide a great deal of information about anatomy and physiology of the creatures. Track casts that pass muster with the experts are impossible to fake but this fact will never be widely acknowledged. It simply requires more study of the subject than most scientists are willing to do. But to those who have evaluated all the aspects of the various kinds of evidence, the consensus seems to be that track casts tell us more and are more compelling as evidence.

The problem with hair samples is that they bear such a striking similarity to our own human hair. It is fair to suppose, based on this apparent fact, that these hairs are not bigfoot hairs at all. Perhaps they are simply human hairs that are collected under the mistaken belief that they are actually bigfoot hairs. The fact that the hairs are collected under circumstances that make them more compelling, such as in conjunction with an eyewitness sighting of the creatures, does not add to the evidentiary value of the hairs, since the eyewitness aspects of the account are unconfirmable. What if we venture outside the strict standards of scientific evidence for a moment and tentatively accept the fact that at least some of these hairs really did come from bigfoot creatures, just as the eyewitness assert? Then these hair samples may be telling us something about the sasquatch that is potentially overlooked and yet very important. The hairs that are being considered as possible bigfoot hairs are essentially indistinguishable from human hairs. It took me a while to grasp the significance of this fact but it may actually be a tremendously important clue as to the origin and nature of these creatures. Could it be that they share a common ancestry with humans that is more direct than has been previously considered? That would help explain the striking similarities in hair morphology.

There are other kinds of evidence that support the bigfoot hypothesis, but the problems get even thornier. Feces, or scat, must exist if the creatures exist and I have acquired a few possible samples that come with good documentation. But don't look for anything com-

pelling to come from the examination of scat. It tells us a lot about the diet of the creature but it does not give us much we can use to prove its very existence. It is generally alleged that the scat comes from bear. If anyone has acquired a suitably fresh scat and then invested the time and money needed to demonstrate the fact that it is truly of bigfoot origin, I am not aware of it. If bones have been found, I am also unaware of that, but I don't discount the possibility. When it comes to the existence of bones, not to mention a carcass or even a live specimen, it must be emphasized that not having knowledge of such evidence is not the same as claiming that such an event has never occurred. All that can be claimed for certain is that such evidence, if it does exist, is not available for public inspection.

Which brings us to the final kind of evidence, which is the only kind of evidence that will seal the deal, and that is all or part of a bigfoot carcass. Grover Krantz has long argued for the need to secure a bigfoot carcass. It is the only kind of evidence that is acceptable to the International Zoological Society, which is the organization that officially recognizes newly discovered species. The only thing that will satisfy their standard of evidence for any new species is the presentation of a carcass or live specimen of the species. Once, the IZS rejected evidence of a new species that was subsequently vindicated. The first duck-billed platypus pelt to be presented to this august body was initially rejected as an obvious hoax.

Remember that scientists are particularly reluctant to accept extraordinary claims. Remember Sagan's line, “Extraordinary claims require extraordinary evidence.” Claiming that bigfoots exist and have been somehow overlooked by science is quite an extraordinary claim. Dr. Krantz is, therefore, quite correct when he contends that we need a body to seal the deal. "Nothing else will do," was one of his familiar phrases. Krantz was widely criticized for advocating the killing of even one of this rare, noble, and even human-like species. One memorable image from a TV documentary depicted Krantz with a rifle in hand at a forest promontory. He took a lot of flak for that one even though many others have entertained similar ideas.

Bigfoot researchers are sometimes approached by such determined but deluded sportsmen who announce their plans to entice a bigfoot into a situation where they will trap or shoot it. Such plans are not just a public safety hazard. To me, it is a plan that is even more futile than it is cruel. I would argue that such bold plans sell these creatures a bit