

Planet of the Primates

Simiancerely,
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Submitted for your approval

“They were apes only yesterday. Give them time.”

“Once an ape – always an ape.”

“No, it will be different...come back here in a age or so and you will see...”

The gods, discussing the Earth, in the film version of H.G. Wells, *The Man Who Could Work Miracles* (1936)

The art of monkeying around with apes

A no chimps allowed, monkey-see monkey-do, ape-solutely ape-ic no apeologize discussion to go bananas over that is more fun than a barrell (or planet) of monkeys, apes, chimpanzees, gorillas, bonobos, orangutans, mandrills, gibbons, tamarins, lemurs, baboons, marmosets, rhesus...

Over fifty years ago, way back in 1968, I was a sophomore in high school and my family, mom, dad, older brother and sister, all went to see the movie, *Planet of the Apes* (POTA), at the Fox theater in Sacramento, where we were living at the time. Due to my interest in SF I was familiar with Pierre Boulle's book and knew about the film from the pages of monster magazines (see also *Famous Monsters of Filmland* covers #80 and #85) so I was looking forward to seeing the movie. Afterwards, all of us were quite impressed and had a good discussion in the car on the way back home. That film is a watershed in cinema history and one still fondly remembered. As each new film was released from the original 5 film run I was at the theater to see them. By the time I saw the last one, 'Battle', released in 1973, I was a junior in college. And here we are over 50 years later and the original seminal simian film still resonates on many levels. To better appreciate the POTA film franchise a little background on our close, hairy cousins is in order. Plus what is necessary for both language and speech for, afterall, the POTA apes do talk. For the record, primates include lemurs, monkeys, apes, and humans.

He went ape

It wasn't too long ago that the stereotype of the ape was that of a savage beast, a killer, driven only by primitive and uncontrollable instincts; ethics have no bearing on his choices. This perception was true during our grandparents time but certainly not so now. Jane Goodall, the famous gorilla scientist, put the final nail in the coffin that apes are beasts with the publicaition of her book, *In the*

Shadow of Man, in 1974, thereby removing all doubt about the 'mysterious and savage' ape. After all, apes are vegetarians and peaceful.

Charles Darwin (1809-1882) started it all by scientific observation and published his findings in his book, "*On the Origin of Species*" in 1859. His thinking of evolution by natural selection, in particular, that man evolved from apes, was considered blasphemous at the time. Many religious groups and conservative people are strongly opposed to anything that has to do with evolution. And over 150 years after Darwin published his book those few proponents of intelligent design (or "anti-Darwinists") just cannot accept a non-religious explanation for evolution or that evolution is even a viable explanation at all. Being at the top of the food chain man thinks of himself as the center of the universe in that he alone can communicate (write and talk), build, and contemplate his own existence. How dare the apes think they too can do this!

"There can hardly be a doubt that we are descended from barbarians." – Charles Darwin.

In 1871, Darwin also proposed that man's earliest ancestors lived in Africa alongside contemporary chimps and gorillas and primarily ate fruit, leaves, seeds, and nuts. As soon as early man learned to obtain foods in open habitats, such as grasslands and savannah woodlands, he rapidly emerged in a separate lineage quite different from his common ape ancestors, some say around 4-5 million years ago. Around this time began the biological, physical, and genetic differences between man and ape. Other than standing upright the major physical differences are facial features, the ape with his brow and flat nose and humans with their prominent nose and high foreheads. Concurrently, man developed a more diverse diet of grasses and meats, and subsequently developed into hominids with all their unique traits. And, of course, language co-developed along with this separate lineage.

The missing Link

For many reasons we humans are fascinated by the apes. Their charm and 'apepeal' seem endless. Man's fascination with the great apes has a long history and being descended from common ancestors probably has a lot to do with it. I still laugh when I think of the TV show, 'Lancelot Link', that featured chimps as spys in human roles so even as TV stars chimps continued to keep us humans entertained. With opposable thumbs, the ability to use tools, and have a social order, not to mention the ability to, well, ape man all contribute to our endless curiosity about them. Frankly, apes are alluring.

In total, there are 264 species of monkeys, of which 22 are apes. Most people do not realize that the difference between the genes of man and those of the apes (the chimpanzee, *Pan troglodyte*, in particular) is amazingly small. At least 98.5% of man's genes are identical to those of the two species of chimps (chimps and bonobos, *Pan paniscus*). That means only a 1.5% difference. In addition, the average human protein is more that 99% identical to its chimpanzee

equivalent. This is why monkeys and apes are used in biomedical research since they are closest to man to test new medicines. This then begs the question, which of our genes makes us human and what does that 1.5% genetic difference look like? The human genome contains somewhere around 20,000 genes and a 1.5% difference means that only about 300 genes differentiate man and ape. (I happen to know some scary humans where this difference is closer to only 50 genes or so...but I digress.) What this miniscule percent difference means is that these few genes gives us the ability to talk, write books and articles (such as this one you are currently reading), create SF films, walk upright, design cancer treatments, etc. Stating the obvious, since man does not look nor act like apes, and viceversa, then these few genes are everything. From a scientist's perspective, changing, altering, and/or mutating only about 300 genes is not that difficult of a task. Human and chimpanzee brains differ substantially, yet their DNA sequences do not.

Human and chimp chromosomes

Naturally, because our genes are similar, chimpanzee and human chromosomes are also very similar; however, humans have 23 pairs of chromosomes whereas the great apes have 24 pairs of chromosomes. Somewhere in the evolutionary past two ancestral ape chromosomes fused together forming human chromosome 2. Of all 23 pairs of human chromosomes there are only 9 major differences between human and chimp. So, do the POTA apes have 24 or 23 pairs of chromosomes?

Here comes Hollywood

Since Darwin effectively showed a close genetic relationship between man and ape it is no wonder Hollywood decided to make films that exploited this magical 300 or so gene difference. Without doubt the granddaddy of all ape films is *King Kong* (1933). Over 80 years later and Kong is still the King. Ape films were a sign of their times in early Hollywood because back in the 1920s to the 1950s apes were news. They were just being discovered, placed in zoos, and described, primarily through the exploits of famous adventurers like Frank "bring 'em back alive" Buck. Frank Howard Buck (1884-1950) was a hunter, actor, director, writer, and collector of wild animals. His very popular jungle adventures were described in both book form and on film and radio and many of the wild animals he brought back alive ended up in zoos for all to see and apes were a particular favorite. Back then apes were considered pop culture.

Scopes Monkey Trial

In 1925, in a landmark legal case, Tennessee high school science teacher John Thomas Scopes (1900-1970) was convicted of teaching evolution to his class. He taught that man evolved from apes. Scopes was found guilty of breaking a newly passed Tennessee law, the Butler Act, forbidding the teaching of evolution in any state-funded school. This legal case has taken on the name of the "Scopes Monkey Trial". Though Scopes was found guilty the verdict was overturned on a technicality and he went free.

Due to the theme of the trial, the teaching of evolution, it drew intense national publicity and both newspapers and radio covered every moment of the event. Though on the surface the trial was simply the State of Tennessee vs Thomas Scopes, in reality, it was the modernists, who said evolution was consistent with religion, against the fundamentalists who said the word of God, as revealed in the Bible, took priority over all human knowledge. As such, the trial was both a theological contest and one testing the veracity of modern science. The publicity surrounding the trial probably more than anything brought the science of evolution to people's attention. Since then the teaching of evolution, that man evolved from apes, has expanded eventhough fundamentalists continue to try to reverse this trend and keep creationism alive.

Also in 1925, Australian Professor Raymond Dart, described the fossilized skull of what has come to be known as *Australopithecus africanus*, the "Taung Child". This was the first member of the *Australopithecus* genus discovered and it certainly challenged the contemporary ideas about human evolution. All the *Australopithecus* bones discovered since then, the most famous being the hominid skeleton known as "Lucy", represent strong proof that man did indeed evolve from apes, a concept that was (and still is) very difficult for some to accept.

Monkey see, monkey do

Anatomically modern humans begin to appear in the fossil record in Ethiopia some 200,000 years ago. This is when human language had its beginnings. Language evolved from calls. After all, mammals do make calls (sounds or cries) that are interpreted by other species. Primates make vocalizations in the wild that are intimately tied to their emotional state and these primates mimicked each others calls. [It should be noted that other species, such as songbirds, whales, and dolphins also communicate via speech.]

Evolution of language

Language is a socially learned tool for communication. There is much debate amongst experts about the origin and evolution of language so theories are 'apeplenty' and there appears to be no general consensus. However, all seem to 'apegree' that language started with vocal communication that complimented gesture communication. It should also be noted that origins of behavior overlap the origins of language. So, various hand/mouth goal-directed movements and expressions became communication (gestural communication is also communication through body language; known as a proto-language). A precursor to Broca's area of the brain (see below) was involved in interpreting gesture recognition into abstract ideas as meaningful action and over time these repeated gestures eventually became associated with sounds (words) with abstract meanings. As sounds/words/speech became more prevalent then Broca's area became the "motor center for speech" that interprets body language, gestures, and decodes speech sounds. In particular, it is the

subcortical and neocortical areas of the brain that are activated during communication so these corresponding areas in apes also need to be developed for communication. Since chimpanzees (apes) do communicate with humans, both on a gestural and vocal level, then this suggests that precursors to human language are already present in ape brains.

Since there is no direct evidence when language began then the best indirect way to study language origins is to examine the fossil record and archaeology evidence. Most likely, when human behavior began to change then language began to appear to better communicate so, as mentioned, language became a socially learned tool to communicate. It is unclear if language slowly evolved, suddenly appeared to become widely accepted and “aped”(!), is genetically encoded, or learned through social and cultural interactions. Maybe all of the above. Also, body painting, such as marks on chest, arms, and face was a custom before articulated speech and such body marks can be considered a form of communication and therefore a proto-language. The shift from manual gestures to vocalization or spoken language also evolved over time.

Gesturing

Gesturing preceded language as perhaps the earliest form of communication. One interesting theory of the evolution of language states that language developed from gestures. However, stating the obvious, one cannot use hands when they are occupied such as by carrying something or holding something (tools), at night when you cannot see, or hiding in bushes so gesturing does have its limits. Gesturing evolved into verbal language more out of necessity and convenience. Early verbal language was onomatopoeic meaning imitating the sound of the action or object such as when a child calls a dog, “bow-wow”. Simple gestures were used initially for communication followed by vocalizations. To support this both gesturing and speech depend upon the same brain systems, the cortex region, which controls both mouth and hand movements. The same left-hemisphere brain region is active during gesturing as well as during vocal or written language. What this means is facial expressions are under neuroanatomical control and this evolved over time as the brain capacity increased.

Another form of gesturing is sign language or Ameslan (for *American sign language*). To support the idea that apes have the capacity to communicate a group of researchers in Nevada taught apes sign language and have been able to achieve a remarkably sophisticated level of communication, complete with syntax, humor, and emotions with the apes. These apes have an Ameslan vocabulary of 100-200 words. And through sign language the apes were able to construct novel sentences and correctly describe objects not seen before. Perhaps even more striking is that newborns in an ape colony that knows how to communicate through sign language are taught the same gestures. All this suggests that the apes have all the necessary tools for effective communication but one. And that is a BIG one! Namely, speech.

Emergence of language

It has been speculated that language emerged somewhere between 200,000 and 50,000 years ago. What this means is that from the appearance of *Australopithecus afarensis*, 2.5 to 3 million years ago to *Homo habilis* (at the beginning of the Pleistocene Age) somewhere around 95,000 human generations of time (4 generations per Century) elapsed for language to evolve. *A. afarensis* had a brain capacity of around 400-500 cubic centimeters (cc) whereas *H. habilis* had a brain capacity of around 500-800cc and made tools so it took around 95,000 generations of human evolution to double brain capacity. Based on this, language development was a gradual progression and not a spontaneous event. It has been speculated that man's language did not evolve from primate communication but rather from primate cognition, which is much more complex. Primate cognition is dependent on brain capacity so more capacity more cognition. There is a general consensus that language probably started somewhere in sub-Saharan Africa sometime during the Middle Stone Age, just about the same time that *Homo sapiens* began to appear. Development of language, tools, and culture occurred simultaneously all driven by an increase in brain capacity.

Origin and evolution of speech

Speech is different from language. Language can also be gestural (signed), written, or involve other forms of body language whereas speech is exclusively vocal. Speech as we currently know it emerged relatively late in human evolution, co-developing with the emergence of *Homo sapiens*.

For human speech, the tongue, lips, and vocal cords are all used for communication and all make up the vocal apparatus. Though primates (and other mammals) vocalize they do not use their tongues to modulate sounds though they do use their flexible tongues for eating. The sounds they make in the wild are intimately tied to their emotional state. The neural controls for primate vocalizations are different from humans. Still being debated is when did humans begin to use their tongues to make sounds for social communication.

The tongue

In most mammals, the tongue is a relatively flat structure and attached via the hyoid bone, just below the pharynx and controlled by the hypoglossal nerve. In humans the tongue has a circular sagittal (midline) shape and is also attached to the hyoid bone, but is lower down. Moving the jaws up and down allows the tongue to vary its muscular cross-section that provides different frequencies. Muscle tongue attachment in humans is at right angles which allows the tongue to pronounce the vowels, 'i', 'u', and 'a', something other primates cannot do. Anatomically, monkeys and apes do not have the anatomical structures to produce a full range of vowel and consonant sounds of speech. [Just so you know, the word 'language' is derived from the Latin, *lingua*, meaning "tongue". 'Linguistics' is a derivative word.]

Speak while you breathe

Humans have the ability to speak while inhaling and exhaling breaths, an ability other primates do not have. When humans speak the intercostal and interior abdominal muscles expand the thorax (chest) to draw air into the lungs and also controls air release while exhaling. These muscles are more pronounced in humans than in the other primates.

Larynx

The voice box or larynx is an organ in the neck that houses the vocal cords and attached muscles. The shape of the vocal tract and a larynx positioned relatively low in the neck are necessary prerequisites for many of the sounds humans make, particularly vowels. For humans, it is important to know that the larynx is descended, something rare in the animal world (goats, dogs, and pigs can temporarily lower the larynx to make loud calls). In other animals the tongue remains horizontal making it difficult for subtle articulation as in humans. In chimps the larynx does descend to some degree though not as much as in humans. Of note is that at least one orangutan has shown the ability to control his voice box.

Language relevant genes

The protein, FOXP2 (abbreviation for ‘forkhead box protein P2’; encoded by the FOXP2 gene), is a transcription factor required for proper development of speech and necessary for orofacial movements. FOXP2 is also known as the “language gene”. This gene is located in human chromosome 7 and is more active in females than males, which may explain why females have better language learning skills than males. The human FOXP2 protein differs from the chimpanzee FOXP2 protein by only two amino acids (amino acids are the building blocks of proteins). These two amino acid substitutions, an asparagine for a threonine and a serine for an asparagine, distinguish the human FOXP2 protein from that found in chimpanzees; these two amino acid changes inhibit the protein’s ability to effectively bind to certain segments of DNA. (Remember, human and chimpanzee proteins are about 99% similar so two amino acid changes in the FOXP2 protein is within this range. Which underscores how important that 1% difference is!) The genetic damage (called a single point mutation) to one copy of this gene (we all carry two copies of each gene; one from each parent) is enough to stop speech and language development. Those humans missing or have an altered FOXP2 gene resulting in speech impairment have developmental verbal dyspraxia.

Broca’s brain

The area of the brain linked to speech, language production, and language comprehension (linguistic information) is called Broca’s area and is located in the frontal lobe of the brain, specifically, the inferior frontal gyrus. Broca’s area is where language is processed including both grammar and fluidity of words. When this area of the brain is damaged then the person has a speech and

language problem, called expressive aphasia (affects writing, reading, speaking, and listening), and cannot make fluent speech. For language, Broca's area involves both semantic tasks and phonological (sound) tasks. Specifically, the anterior portion of Broca's area is involved in understanding the meaning of words whereas the posterior part of Broca's area is involved in understanding how words sound. Apes do not have a well developed Broca's area.

Speech associated gestures along with speech help improve comprehension. Those who use sign language may also suffer from language deficits, which is also located within Broca's area. Gestures are translated into words within Broca's area suggesting that speech evolved from a primitive communication that arose from these gestures. When there is underactivity within the Broca's area then a stuttering speech disorder occurs.

In primates, their Broca's area is responsible for controlling the muscles of the face, tongue, mouth, and larynx, as well as recognizing sounds. Though primates have been known to make "vocal calls" for communication it should be noted that these calls are generated by circuits in the brainstem and limbic systems and not their Broca's area.

Development of language in humans.

The role of parents in speech development is critical. Parents stimulate the development of speech in infants by responding to infant babbling. Though no words are spoken parents respond to calls from infants and this stimulates language development. The same would also apply to primates. And from the development of language came various dialects and 'tongues'. Do all POTA apes speak English or do others, for example, those in Europe or Asia, speak different dialects?

Evolution of speech and language

Human speech and language are highly complicated. For speech and language physiology must be connected to anatomy and vice versa since brain development is *both* physiology and anatomy. Vocal plasticity enables the ability to learn novel sounds and call structure in responses. For this, a vocal tract is critical. Also, in communication, species take turns (turn-taking) in "speaking" or communicating which is also critical for language. Anatomically, primates need a flexible supralaryngeal structure for speech (having the wrong FOXP2 protein is the culprit). Furthermore, monkeys and apes need the cognitive, motivational, and articulatory mechanisms to create speech. Monkeys do not have the genes necessary for fluid speech, rapid articulation, and sequencing of sounds. However, as is, the ape brain is already complex so very little is needed to install speech since they appear to already have "language" or the capacity for language. What should be kept in mind is even with a chance mutation where apes have the ability for speech it would not be a useful adaptation since there is no inherent social structure to take advantage of a talking ape. A social structure, one that enables the (ape) public to effectively communicate, must also

concurrently develop with language to make an effective evolutionary adaptive strategy. [note: to be effective and durable this mutation must be stable and reproducible.]

Development of writing

Writing is the expression of language by graphic means. Proto-writing was the ideographic expression of symbols or glyphs. Pictographic images morphed into ideographic images that in turn morphed into a phonetic system. Writing was first expressed in Mesopotamia about 5000-6000 years ago and the oldest actual writing may be cuneiform. Phoenicians developed the alphabet. From writing developed complex grammar, sentence structure, and then literature.

Evolution of the frontal lobes of the brains of primates

As early human primates evolved and separated from the great apes their cerebellum had a more pronounced development. Since the cerebellum controls sensory-motor control and assists in learning complex muscular action (like mouth, tongue, and vocal tract movements) it may have helped the evolution of human adaptations for speech. Again, physiology and anatomy of the brain co-developed and along with this increased capacity came the ability for language.

Ape neuroscience

The POTA ape brain is quite sophisticated and on the same level as 21st Century man. Therefore, these apes must have cognition, ability to think, feelings, self-awareness, abstract thoughts, and be able to observe inanimate objects. And in order to do that they must have all the necessary neural circuitry. Large areas of monkey brains are used exclusively for social interactions, which is essentially communication. For ape brain development selective pressure must then be applied to develop these communication skills. All this requires the proper neurological development for communication. For the POTA apes sensory and motor systems are also necessary for multiple components of speech and language. At face value the brain – or the “mind” - is a result of its anatomy and physiology, and ultimately, from DNA, and nothing more. The function of the brain is different from the mind of the brain. Apes may have most of the function but not the mind of a human brain.

Brain capacity

The modern chimp brain has an average volume of about 400cc. The *Australopithecines*, who walked on two feet, had a brain volume of about 500cc. Modern gorillas also have a brain capacity of 500cc. *Homo sapiens* have a brain capacity of around 1100-1300cc so the modern human brain is about three times the size of chimp brains and a good portion of this is occupied by Broca's area. And, stating the obvious, to increase brain capacity the cranium must also increase in size to accommodate the growing brain. (And absolute brain and cranium size is limited by the size of the female pelvis and birth canal.)

What would it take to make an ape speak?

For an ape to speak they would need to enhance both their physical and cognitive abilities. Their brain volume will need to increase, their larynx and tongue will need to be modified, their Broca's area will need to enlarge, and, just as important, they will need to develop a social structure to support language and speech. Biochemically and genetically their FOXP2 protein will need to change those two amino acids for proper speech ability. Interesting questions are what would happen if, say, the genes that control the development of the larynx, our voice box, and the cerebellum (Broca's brain area where language is centered) were genetically engineered into a chimp thereby giving him the anatomy needed for speech? Well, shades of Doctor Moreau and the Veterinarians of Planet of the Apes! Though all this is feasible, you will still need the social structure to support these adaptations. And for social structure you will need a colony. It takes decades and generations to develop a sustainable colony. Lastly, do the humans in POTA have the chimp version of FOXP2 or do they still have the human version but one or both of their two genes has mutated?

The ability to ask a question

Questions are considered by some what separates humans from non-humans. Though captive primates can communicate with signing, often in complex ways, they have yet to ask even the simplest of questions. Questions are a measure of inquisitiveness. Questions involve certain cognitive developments necessary for complex communication. With a limited brain capacity of around 400-500cc apes do not have the necessary tools for *complex* cognitive communication.

What it means to be human

What does it really mean to be human? What are the boundaries between humans and apes? Is there more to it than just those 300 or so genes? Involved is one's sense of personal identity as well as control over one's own destiny.

Humans and apes obviously look different eventhough we share about 98.5% of the same DNA. Ask 10 humans what it means to be human and most likely you will get at least 10 different answers. Love, laughter, communication, art, and technology all combine to make us humans. However, some other animals do these things too. There are other tool users and innovators in the animal kingdom so that is not a uniquely human trait. What really makes us human most importantly is humans are self-aware and have identity, we reason, we have ideas, we test them, and we make conclusions. Does rewiring the brain alter identity? Life experiences shape human identity. Alterations of even a single gene may profoundly affect a person's identity. An important element of intelligence is self-awareness which is brain cognition or brain identity so would the genetic rewiring of the brain alter identity? The potential to manipulate genes to improve the quality of life is within our abilities. We can enhance our physical and cognitive abilities so this is now an ethical question. We have control over human destiny but should we? Manipulating the genome (human or ape) has the potential to modify one's self-identity. Genes can be changed but the result(s) can be unpredictable, maybe even riskier. Our minds make us human.

Gene jumpers

What truly shapes humanness from others is what are called transposons (transposable elements) or “jumping genes”, meaning small bits of DNA that literally jump (or hop) around our genomes. So you gentle readers are better informed, about 50% of the human genome is made up of transposons.

Transposons are important in embryo development, our immune response, and how we think. Transposons are Nature’s useful genetic tools that help species adapt to their environments (i.e., take on new characteristics) and were the key DNA genetic tools used for vocal anatomy to appear that helped separate human development from ape development. Since humans can talk and think we can thank transposons for this.

The 300

As mentioned, it took approximately 95,000 generations of humans to separate those 300 or so genes from our ape ancestors. For those magical 300 or so genes that separates humans from apes what would happen should that difference be only 200 genes? Furthermore, what if this difference were only 100 genes or, shudder, only 25 or so genes? It’s all a matter of degree. Would we have hairy humans or hairless apes? Either way, both would have speech.

Can there really be a planet of apes?

What would it take for apes to dominate Earth? What is the feasibility? When you get right down to it the leap from ape to human is miniscule. Apes can already communicate but what is missing is effective communication and self-awareness. This would require future ape brain evolution. Though man has the ability should we enhance the physical and cognitive abilities of our great ape cousins?

THE FILMS

There are 5 films in the original POTA franchise that were produced over a 6 year period and they are listed below in chronological order of release. In these films we only see the great apes: gorillas, chimpanzees, and orangutans. No mention is seen of other primates (though this is no doubt a budgetary decision). And quite frankly, just about all other animals are not seen with the exception of horses and one squirrel (from ‘Battle’; dogs and cats all died of a viral plague; no cows (so no milk), sheep, pigs, etc. were seen as well as no domesticated beasts of burden). These films can easily be seen as social commentary in describing man’s hubris and self-importance.

Planet of the Apes (1968)

Brief synopsis

Astronauts are sent into space under cryogenic sleep to a seemingly distant planet. Unfortunately, the astronauts went through a time warp and ended up landing on (spoiler alert!) distant future Earth. This future Earth is populated with

apes that talk and humans that are mute and slaves to the apes. One astronaut, Taylor, survives, is caught, then escapes, only to find his destiny that he did indeed land on future Earth.

Time travel / cryogenic sleep

Just before Taylor places himself in suspended animation while in space we note the spaceship chronometer which read, Earth time: 3/24/2673; and ship time: 7/14/1972. Taylor records his thoughts. "Earth has aged nearly 700 years since we left" (he commented that they were traveling at speed of light). At this time he places himself in suspended animation for the rest of the trip.

When the spaceship landed on the future planet Earth the ship's chronometer read: 11/25/3978; meaning they were away from Earth for 2006 years or about 80 generations of humans (4 generations per 100 years so 2000 years = 80 generations) and maybe 100 generations of apes (5 generations per 100 years). After landing, one of the astronauts says, "not so much where we are but when we are."

After crash landing and awakening the men seem to have a 2-3 month of beard growth and not the decades or (implied) centuries of suspended animation suggesting that overall body metabolism was severely inhibited during their hibernation.

The ape culture seen is a contradiction, advanced in some areas but primitive in others. Seen are domesticated horses (with saddles so knowledge of leather), guns (metalurgy) and metal cages, wood wheels (not metal), photography with a "19th Century" style camera, complete with flash powder for light (photography implies chemistry since chemicals are needed to develop the film and prints), kelly clamps (for surgery; also metal), clear plastic tubing (polymer chemistry), cigars (tobacco growth and harvesting; complex agriculture), corn fields, tools & instruments (in lab), parchment and perhaps vellum but no paper, textiles (sewing?), and outdoor market with foods. Also seen are surgical instruments such as scissors, files, metal tray, knives, and clippers. Some items are quite sophisticated and implies a significant society infrastructure for manufacture to be able to provide such items. Another example is they used a high-pressure water hose to control humans. The nozzle is metal and sophisticated. Where does the water pressure come from? Other items seem purposely 'primitive' to suggest these apes are not especially advanced. Also, these apes have the ability to walk upright and not on 'knuckles'.

In one conversation with astronaut Taylor, Cornelius the ape says, "Flight is a scientific impossibility" so Taylor makes a paper airplane. (Note: no paper is seen in the POTA film franchise. Instead they use parchment. Parchment is a writing material made from specially prepared untanned skins of animals—primarily sheep, calves, and goats. It has been used as a writing medium for over two millennia and apparently into the distant future too. (So you know, vellum is

a finer quality parchment made from the skins of kids, lambs, and young calves.) None of these animals were seen in the film.)

The chimp, Dr. Zira, is an 'animal' (i.e., human) psychologist and her husband, Cornelius, is an archaeologist. Where did Zira and Cornelius get their advanced training? What sort of education system do they have? In the course of her work Zira developed a theory: "ape evolved from a lower order of primates, possibly man...a planet where apes evolved from men." In a conversation a gorilla asks orangutan Dr. Zais, "What is Dr. Zira trying to prove?" Zais responds, "That man can be domesticated." It is interesting that apes can pronounce Zira's and Zais' name, which contains the vowels, "i" and "a" so their tongues have the muscle structure necessary to do so.

Zira says, "I've found no physiological defect to explain why humans are mute. Their speech organs are adequate. The flaw lies not in anatomy but in the brain." Perhaps the Broca's area of this group of future humans has either diminished or mutated to not be as effective. Also, there may be a problem with their FOXP2 protein. At a trial, Zira is accused of "tampering with his (Taylor) brain and throat tissues to produce a speaking monster", says a lawyer. The concept of 'throat tissues' implies knowledge of anatomy and what is required for speech.

POTA apes have a complex society with rules, laws, and governing bodies. And their religion strongly influences all matters of life, behavior, and beliefs. To the apes the humans are "beasts of the jungle". In their belief apes have a soul whereas humans (i.e., beasts) do not. In one query, "Why are all apes created equal?" Taylor responds, "It seems some apes are more equal than others", (to paraphrase George Orwell's, 1984). However, the "ancients" (i.e., apes) kept the human beasts as household pets.

Cornelius the archaeologist supports the theory that the ape evolved from a lower order of primates, possible man. Cornelius maintains that apes have ascended from barbrians. For Cornelius, Taylor is a "missing link" between unevolved primate and ape. From his archaeological discovery in a cave Cornelius says, "the more ancient culture is the more advanced...Man was here first...The more ancient culture is more advanced." Cornelius discovered eyeglasses, false teeth, and a doll that says "ma...ma". Taylor asks Zais, "would an ape make a human doll that talks?"

Taylor wonders that if man was here first why didn't he survive? A planet where apes evolved from men seems difficult for Taylor to imagine. Taylor and his female (Nova) go out on their own and Zira asks Zais, "What will he find out there, Doctor?" Zais responds, "His destiny." (i.e., mostly buried Statue of Liberty).

Here are some favorite quotes from the film:

“human see, human do”

“Amusing, a man acting like an ape. He has a gift of mimicry” – Dr. Zais in reference to Taylor

“Man has no understanding. Man is a nuisance.” Zais

“It’s a question of simian survival” Zais

“Take your stinking paws off me you damn dirty apes.” Taylor

“I never met an ape I didn’t like.”

“It’s a madhouse! A madhouse!!”, Taylor

“A man has no rights under ape law”, Zais

“The Almighty created the ape in His own image.”

“The proper study of ape is ape.” Zais

“An insidious theory called evolution”, Zais

Zira says, “Taylor can think and reason”

(humans are) “a menace, a walking pestilence”, Zais

“All men look alike to most apes”, Zira

Beneath the Planet of the Apes (1969)

Brief synopsis

A second spaceship is sent to find Taylor that also crashes on future planet Earth. On board is astronaut Brent who is captured, escapes, and locates the underground human population. These mutated humans can communicate telepathically. The apes find the city and all is destroyed at the end by the Doomsday bomb.

This film essentially starts when POTA ended. To explain his objective, astronaut Brent says he was, “following Taylor’s trajectory.” He said he “passed through a band of time” to get where he is. According to the ship’s chronometer Brent’s spaceship landed in the year, 3955 (Note: 23 years earlier than Taylor, who landed in 3978!).

Seen in the ape city are are canons (where and how is gunpowder made?), handguns, a sauna, and knives; all suggesting sophisticated infrastructure manufacturing and metal work. We see organized military exercises with weapons. Their horses have saddles and bridles. The wheels are made to look primitive as solid with no spokes. No tires or rubber are seen.

While following Brent the apes journey to the Forbidden Zone and manage to locate the human’s underground city. These underground humans communicate by telepathy and use illusion as “psychological warfare” instead of weapons. Since telepathy is mental these humans must have developed significant brain/mind capacity (again, in about 80 generations) while underground.

In a tragic case of worshipping ‘false gods’ these humans pray to a Doomsday bomb which has Greek, “alpha” and “omega” symbols on the tail fins. The underground human high priest prays: “Glory be to the bomb and the holy fallout

as it was in the beginning, is now, and forever shall be world without end. Amen.” Furthermore, he adds, “May the blessing of the bomb almighty and the fellowship of the holy fallout descend on us all this day and forever more.” [Note: the presence of the ancient Greek letters, alpha ‘α’ and omega ‘Ω’, meaning the beginning and the end, on the bomb fins strongly suggests that ancient language did survive into the human future but not the ape future. This highlights the radical difference in direction the above ground apes and the underground humans took.]

In one dramatic scene the underground humans pull off masks to reveal “inner selves” with their translucent skin and clearly seen blood vessels. Though these underground humans have developed telepathy they still have speech, which they primarily use while singing. Based on one scene telepathy works at least 50 feet apart in direct mental communication. Earlier, illusion images of fire and a bleeding ape Lawgiver were seen that must have been controlled from a distance. These humans also used illusion and mental control to cause Taylor and Brent to fight each other.

Some favorite quotes

“The only good human is a dead human.” – General Ursus

“Ape shall not kill ape” – the Lawgiver

“Man is evil. Capable of nothing but disaster.” – Dr. Zais.

Escape from the Planet of the Apes (1971)

Brief synopsis

Three ‘ape-o-nauts’, Zira, Cornelius, and Milo, escape from a future Earth and through a “backwards disturbance in time” end up landing off the coast of Los Angeles in 1973. The apes are initially treated as animals only to learn they can speak. Zira is pregnant and delivers a baby ape. The government wants the apes destroyed and do so except the baby ape survives.

After landing off the coast of Los Angeles the three ape-o-nauts are taken to the LA Zoo infirmary and placed in a cage next to a gorilla. Unfortunately, the gorilla kills Milo. Before he is killed, Milo explains that due to a “backwards disturbance in time” they returned to Earth’s past. This suggests a deep understanding of complex and cutting-edge physics. (Was this learned from leftover human books or something chimps ‘independently discovered’ on their own?) Since Cornelius clearly states in POTA that “flight is a scientific impossibility” it is difficult how one can understand time and relativity and not think flight possible.

In the modern world of 1973 apes at this existence in time can not yet talk. After performing a series of simplistic psychological tests Zira was given a reward, a banana. When the humans noted Zira did not take the fruit they wondered why. This is when Zira spoke her first words, “Because I loath bananas!” Zira further comments, “We can speak so I spoke.”

At a hearing, Dixon, an animal psychologist, says “these two apes have acquired the power of speech. “She (Zira) can articulate”. It was suggested that maybe this was mechanical mimicry. However, a moderator at a hearing comments, “Does the other one talk (Cornelius)?” Cornelius responds, “Only when she let’s me.” Humor is a sophisticated means of communication and implies high brain order and capacity. In additional conversations Cornelius says, “God created the ape in His own image.” Also, “Where we come from apes can talk and humans are dumb.”

Cornelius explained that a virus brought back to Earth by astronauts (in 1983) killed all dogs and cats so humans had no pets. As a result, humans took apes as pets. As Zira explained, in “less than two centuries”, pet apes changed from doing tricks to doing services and menial tasks (such as cooking, getting groceries, etc.). Zira continues and says, “after three more centuries” apes learned to refuse and became immune to slavery. All the seeds necessary for their evolution revolution.

Cornelius further explains, in ape history the day is celebrated when ‘Aldo’ articulated the first word: “no”. Therefore, Aldo must of had the correct form of FOXP2 that allowed speech so his FOXP2 protein mutated to exactly resemble human FOXP2 for proper speech functions.

In another conversation Zira explains that apes of the future are advanced enough to perform experimental brain surgery (which implies anesthesiology procedures and all that goes with it). They frequently performed frontal lobotomies on humans (note: better to have a bottle in front of me instead of a frontal lobotomy). Zira also dissected humans to see if she could “stimulate atrophied speech centers” in humans (meaning Broca’s area).

Time out

When asked Zira says they left future Earth during the year, “Thirty-nine fifty something” when they landed in 1973. According to ‘Beneath’ the Doomsday bomb exploded in the year 3955 (again, 23 years before Taylor lands in POTA) so ‘thirty-nine fifty something’ is close enough to be consistent.

Born to Zira and Cornelius while at a circus is baby Milo and the film ends with Milo articulating the word, “ma ma”.

Conquest of the Planet of the Apes (1972)

Brief synopsis

In 1991 North America apes are seen as slaves and trained to do simple tasks such as shine shoes, sweep, carry boxes, etc. These apes are under strict social control. Caesar, who survived from “Escape’, is now 20 years old and raised in a

traveling circus. Caesar organizes his fellow apes as activists and they stage a revolt known as “The Night of the Fires”.

CEO (Chimp Executive Officer)

The film begins by referring to “North America, 1991”. At this time all apes, chimps, gorillas, and orangutangs, who were treated as pets in the beginning, but soon are seen as slaves. They are trained to do simple tasks by conditioning and re-conditioning so they have “communication” and the ability to learn but no language (yet). Also, we see hand signals to communicate with orangutans so some Broca’s area development may have occurred. The chief CEO chimp is Caesar, who is 20 years old so he must have been born in 1971. The film time for, ‘Escape’ was 1973, when ‘Milo’ (aka, Caesar) was born so maybe he is only 18! Apparently, Armando, the human circus ape trainer, whom Zira and Cornelius placed their son in his care, changed his name from Milo to Caesar.

In one scene apes gather in a mall and a loudspeaker voiceover says it’s unlawful and “masters (of apes) will be cited and fined.” At this time society appears like a police state and no unauthorized ape gatherings are allowed.

It was stated that all dogs and cats were decimated in a 1983 plague (a virus from outerspace brought back by astronauts) so apes now serve as pets. However, most likely there were not enough pet apes at the time to satisfy demand so more apes were encouraged to get pregnant to repopulate their numbers. This would require at least one generation to double the population size. One ape generation is 20 years so for Caesar, one generation of apes grew up with him. With a doubling of the ape population from circa 1971 to ‘Battle’s’ 1991 there still would not be enough apes to satisfy the pet market/demand.

Revolting behavior.

Governor Breck (a real bad guy) wants to prevent the day when apes begin to think and talk. “Brightness has never been encouraged among slaves”, he says. Breck wants to capture Caesar and the ape trainer, Armando, jumps out a window to kill himself rather than have the authorities know the truth about the existence and whereabouts of talking Caesar. During Caesar’s growth Armando motivated the ape to rebel and also ‘train’ other apes to disobey. Understanding what is required, Caesar comments, “We cannot be free unless we have power”, so the apes revolt and quickly learn how to use weapons.

Night of the Fires

The apes revolt and set the world ablaze. As the ape revolt appears to be successful Governor Breck says, “This is the end of human civilization and the world will belong to the planet of apes.” At one point the apes were ready to kill the Governor, but Caesar says, “No. We who are not human can afford to be humane”. Caesar says, “Tonight, we have seen the birth of the planet of the apes.”

Battle for the Planet of the Apes (1973)

Brief synopsis

In the not too distant future Earth both humans and apes apparently live in harmony and work together. The apes resent being dominated and an ambitious gorilla leads a revolt against humans. In an all out battle both sides try to dominate.

As stated in the film's introduction the action takes place in "North America, 2670 A.D." An orangutan narrator comments that this film is the story of Caesar, "in those far off days". Caesar, the son of Zira and Cornelius, was actually named, Milo in 'Conquest'. So, an ape narrator from 2670, approximately 700 years in the future (2670 - 1973 = 697 years), representing only 35 generations of ape development, is describing Caesar's effort to organize apedome.

Timelines

The timelines in this film are confusing. Based on the year 2670A.D., this represents about 28 generations of humans from 1973 before they had the stigma of inferiority compared to apes. 'Battle' begins where 'Conquest' ends. The contemporary time of 'Conquest' was 1991. Caesar in 'Battle' has a teenage son, named Cornelius, so this means Caesar could be around 30 years old which would place the film's contemporary time around the year 2020.

Contrasts of technology

It was established in the film that the ape colony had relatively primitive technology. Later in the film, the underground humans have access to all sorts of technology such as computers (which needs electricity; where are the power generators?) and cars (where do they get the gas and where is it processed?). Based on what was available to the apes in 'Conquest', a mere 30 years earlier, they appear to have completely forgotten all that they had, or that a young Caesar had learned. With so much prior technology and materials available before the 'Night of the Fires' that destroyed all cities some of it would survive and be available for re-purposing. No items such as old chairs or tables, etc. were seen with the apes. Everything they had purposely looked primitive, though no real reason why they should be.

In one conversation an orangutan, the intellectuals of the apes, made an analogy of alternate timelines by discussing a "motorway" composed of many "lanes". This analogy suggests the ape knew about cars, highways, and time relativity, all quite sophisticated technologies, but yet they have no electricity nor the understanding of flight.

For a school lesson to apes they are taught that "ape shall never kill ape". The ape children use "charcoal sticks and parchment" as school supplies. It is interesting that apes continue to not have paper while the underground humans

do. For an additional lesson, “an ape may say, ‘no’, to a human but a human must never say, ‘no’, to an ape. The apes called the word, ‘no’ a “negative imperative”. As with the other films in the POTA franchise no beasts of burden nor other mammals were seen. However, one single squirrel is seen so at least one mammal survived the ape-human conflicts.

In preparation for a major war the apes have a massive armory which raises the question of how do apes make ammunition? This would require gunpowder, metallurgy, and manufacturing not only the bullets but shell casings too.

The radiation exposed humans live in a ‘nuked’ city (New York City?). Everywhere are seen the devastated city, rubble, crumbling buildings, and flattened areas. With all of this there should be significant lingering background radiation and radioactive rubble that contributes to mutations. The humans who live underground are deformed (facially) due to excessive radiation exposure. “These humans are the end product of nuclear radiation...they’re mutants.”

In one conversation between the human Governor and an aide the aide comments that the apes are “more than an animal.” The Governor responds, “Speech makes them (apes) human?” The aide replies, “Speech makes them intelligent and intelligence makes them not human but humane.”

SUMMARY

Confusing timelines

During the course of these 5 POTA films a somewhat strict timeline is adhered to, more or less, though there are a few glaring gaps. The biggest is the start of ‘Conquest’ which is “1991” and the beginning of the next film, ‘Battle’, supposedly takes place right after the end of ‘Conquest’. However, ‘Battle’ is said to take place during 2670 so there is a 679 year gap that is unaccounted for between these two films (which means 34 generations of apes and 27 generations of humans).

Do the math

OK, to save you the trouble I will do the math for you. As assumptions, for every century (100 years) there are 4 generations of humans (25 years per generation) and 5 generations of apes (20 years per generation). Human language developed between 200,000 to 50,000 years ago so during these 150,000 years, which represents about 6000 generations of human development, man developed language communication. The first written words were made around 5,000 B.C so it took another 1800 generations for man to develop writing after developing language. Therefore, it took a total of $6000 + 1800 = 7800$ generations for man to go from developing language (speech) to writing.

According to the ship’s chronometer from the POTA film the Earth date was 1972 whereas the spacecraft time was 3978 when they landed on future Earth so 2006

years elapsed (3978-1972 = 2006). This means about 80 generations of humans and about 100 generations of apes were born during these future 2000 years. Also, Dr. Zais states that the 'sacred scrolls' were written by "the greatest ape of all, 'The Law Giver'" some "twelve hundred years ago" so 3978 minus 1200 equals the year 2777, the 'approximate' year of when "Battle" took place (2670 A.D.). So, from 1972 to 2777 is a near 805 years and during these 8 centuries all it took was 40 generations of apes to develop language, both spoken and written (compared to man's total of 7,800 generations to achieve the same results). And for humans, from 1972 to the time of "Beneath", 3978 AD, are 2006 years and during these 20 centuries, or 80 generations, humans developed telepathy. Which then begs the question of which brain region developed telepathic powers?

Behind the planet of the apes

It was established in "Conquest" that a plague killed dogs and cats in 1983 so there were no house pets and as a result human took apes as pets. As Zira says, in 'Escape', pet apes changed from doing tricks to doing services (cooking, getting groceries, etc) in "less than two centuries". Two centuries means 10 generations of chimps. Also, Zira says, "after three more centuries" (15 generations) apes learned to refuse and became immune to slavery. Therefore, after 500 years, just 25 generations, apes went from pets to self-awareness and able to socially communicate. This is essentially accelerated evolution and remarkable progress! For us near anthropoid human primates it took us thousands of generations to achieve the same results!

Just ape-bout done

The order of appearance of levels of communication of emerging mankind first started with primitive vocal or alarm calls. From this appeared gesturing (use of hands, body, and facial expressions; also sign language) which began millions of years ago. Language with the use of tongue, teeth, lips, and breathing began about 200,000 to 50,000 years ago. Writing began about 5,000 years ago.

As Dr. Zais says, "The proper study of ape is ape." For our POTA ape films, much has changed in our understanding of the great apes and evolution. As a result of the Scopes Monkey Trial the public debate over evolution was strong. A few years later, in 1932, the word "evolution" was mentioned in only 3 films, a rarity at the time, and is a major plot point of the film, *Murders in the Rue Morgue*, quite sensational at the time. As a result of World War II desensitizing people to real horrors society was willing to entertain themes of man evolving from apes which seemed tame to those at the time.

The plots for our favorite POTA films are now becoming a scientific reality. In the real world the great apes are learning effective communication through sign language. Their complex vocabulary is impressive so at least they have the brain capacity for this ability. What is mostly lacking are the proper tracheal, tongue, and larynx muscles for speech. No doubt apes also have a Broca's area

equivalent, though limited, in their brains otherwise they wouldn't be able to develop a broad base of sign language abilities. So, after maybe a few hundred generations of apes, and not the 40 generations implied in the POTA films, they may finally acquire a meaningful language or possibly the ability to speak. Maybe in the not too distant future you will go to your favorite coffee shop and your order is taken by an ape! (What kind of hair net would they have to wear?)

Disclaimer: no primates were harmed in the preparation of this article.

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