EPISODE 37
INTELLIGENCE

Hi there. Welcome to the end of the world. My name is Michael Folz. And this is Episode number 37 of my podcast Dial It Back Or Die. Now on this episode we're going to start examining some of the unique features of the human condition, the killer apps as it were, which clearly and definitively do separate us from all that has come before.

And the first and foremost of these is, of course, our intelligence.

Although I do want to concede, right here at the outset, that other animals can be pretty smart.

And they also can have distinct and rather interesting personalities.

Now both of these statements would have been considered totally unremarkable throughout most of human history. After all, before the modern era almost all humans were in constant company with a whole range of domesticated animals. And they also had far more intimate contact with the behavior of wild animals, whether those wild animals were mice or bears. So it was easy for people to notice the clever ways in which crows or monkeys or bears would steal food, or the memories which dogs or elephants would display when they recognized their owner after years of separation. As for personalities, these were commonly noted both for individual species and between individuals in any given species. Farmers recognized that even cows, considered to be among the dumbest of animals, were still possessed of personalities.

Even well into the 19th Century scientists took these insights as givens. For instance, Charles Darwin, the primary theorist of evolution, fully accepted that animals had distinct personalities. And he wrote copious notes about many perceived semi-human characteristics.

But for most of the 20th Century formal science actually held the opposite view. To be a scientist fifty or so years ago, you pretty much had to believe that when a person thought that they saw a dog being happy, or an elephant grieving for its dead friend, what they were actually doing was

anthropomorphizing. That is to say, they were merely projecting their human feelings onto a world that had no true thoughts or feelings.

From the vantage point of this podcast this is pretty much a direct result of the social sciences having arisen from the ideology of John Stuart Mill's liberal democracy. Which—and I shouldn't have to remind you by now—arose entirely from the theory of utilitarianism. The foundational assumption of which was that the entire point of human existence is the accumulation of pleasure utiles. And, that being the case, then this meant that most of what we thought of as *human* personality and reflection really wasn't there. And if *that* was the case, how much less so could personality and reflection exist in animals?

And perhaps the best example of how this type of thinking permeated the 20th Century was the *behavioralism* championed by the psychologist B. F. Skinner from around 1940 to 1970. Starting with experiments that had pigeons pecking at buttons in order to get food pellet rewards, Skinner then generalized that this simple mechanism of positive reinforcement was responsible for *all* behavior, both animal and human. In other words, in his mind at least, this seemed to prove the idea that we—and especially the lower animals—arrived on this planet at birth with a totally blank slate of personality and thought. And that then of course the simplistic motivating force of seeking pleasure and avoiding pain kicked in.

The theory was very Lockeian, very Humeian, very Age of Enlightenment. In fact, it was pretty much Jeremy Bentham verbatim. And it was extremely influential and popular in the middle of the 20th Century. So that—with such a powerful paradigm holding center stage—it would have been ludicrous, not to mention so unscientific, to believe that animals could think something through, or—even more laughable—that they would have emotions or even hints of personalities.

But as the century progressed, and as researchers such as Jane Goodell and Diane Fossey spent long periods with chimpanzees, gorillas, elephants and other large mammals, it became clearer and clearer to them at least that they were dealing with complex social groups of well defined individuals, each with their own proclivities and peculiarities. And as researchers taught creatures as diverse as parrots, bonobo chimps and border collies vocabularies of up to a thousand words, and as they documented instances where these creatures showed an understanding of very basic grammatical rules, and were able to form simple sentences which showed deliberate thought on their behalf, it became harder and harder to pretend that something rather intelligent wasn't going on.

So that by now the tide has mostly turned, and pretty much everyone is on board with the notion that many animals are much smarter and more personable than even pre-Skinner scientists such as Charles Darwin had given them credit for. It seems that, well before homo sapiens burst upon the scene two or three hundred thousand years ago, various disparate animals were already figuring out quite a few things on their own.

Consider, for instance, the octopus.

Now if you are not already aware that these strange eight tentacled critters are relatively highly intelligent, this example might really surprise you. After all, octopi are not vertebrates, like fish, reptiles, birds, other mammals, and us. They are molluscs, a phylum which also includes oysters, snails, and slugs. Lacking much of a brain, not to mention a spine or a central nervous system to coordinate actions or 'thoughts', you would not think them capable of much more than wandering around and eating.

But here's some of what they can do: They are amazingly dexterous, and can undo the caps of baby proof medicine bottles. In experiments they have been shown to have both short term and long term memory. In captivity they arrange objects in a circular pattern in their tanks and then move them around. They have been observed learning from observing. They also can figure out how to get out of their tanks to search for more food. In the wild they gather shells, carry them a distance, and then build shelters out of them. Some species communicate with each other and hunt collectively. A few years ago one of them, named Inky, became famous for one night climbing out of its tank in an aquarium in New Zealand, slithering across the floor, and escaping through a drain pipe into the ocean.

All in all, not bad for a cousin of the clam. Also for something that usually only lives for one or two years.

What's even more amazing is how their brains are organized. They do possess around 300 million neurons. But unlike vertebrates the majority of these neurons are not in their heads. Instead most of them are distributed along their arms, so that in a sense each tentacle 'thinks' independently of the head. I say 'in a sense' because at this point we have little idea of what is actually going on. What we do know however is that evolution has created a brain system which is organized completely differently than it is in the so-called higher mammals. But that it works quite well nonetheless.

And a similar sort of observation can also be made for bird brains.

Because it had always been thought that, no matter how large they were in proportion to their bodies, the brains of birds were just too physically small to provide all that much intelligence. And this would undoubtedly be true if they were organized analogously to ours. But they're not. Nor are their brains anything like that of an octopus.

Instead—to put it very simply—whereas our brains have different areas which (as we shall see) are connected to each other with various pathways, birds have folds which lie on top of one another. They also have specialized structures which aren't anything like the structures in our brains. The result is that evolution has crafted a way in which a whole lot of thinking can be crammed into a relatively tiny amount of space.

For instance, the Clark's nutcracker, a member of the crow family, can specifically remember where it has hidden over ten thousand different nuts. A captive crow can figure out on its own, from scratch, how to twist a piece of wire into a hook with which to open its cage. It has been shown that crows can count up to at least six. A magpie (another crow relative) can recognize itself in a mirror, a feat which was once thought that only humans were capable of, and which is now commonly accepted as evidence of an awareness of self.

But members of the parrot family have displayed even more remarkable intelligence. One of the best examples of this was an African grey parrot named Alex that lived for thirty years under the tutelage of an American researcher.

Alex knew over a hundred words. That is to say he actually *knew* the meaning of these words, and wasn't simply, er, parroting them. He could count up to six. He could recognize fifty different objects. He could ask simple questions. He knew the difference between 'bigger' and 'smaller'. He would get annoyed with someone who gave him something other than what he had requested. He could get bored and tired of the research, and would say 'Wanna go back' if he wanted to be put in his cage, or 'Wanna go tree' if he wanted to be placed by a window that looked outside.

And Alex was no doubt smarter than your average parrot. But he was still possessed of a relatively tiny brain that, until he came along, no reputable scientist would have thought remotely capable of such conceptual ability.

On the other hand, both dolphins and elephants have big and convoluted brains, and throughout history they have been thought to be highly intelligent. Modern science has pretty much confirmed this. They learn by observing, recognize themselves in mirrors, and can solve rather complicated

puzzles. They have great memories, great powers of mimicry, and love to play. They are highly co-operative and seem to show genuine altruism. Interestingly, they both have highly cohesive matrilineal social groups, and they both seem to innately like us humans. Finally, they seem to be almost the only other animals besides humans that mourn their dead.

Not to mention that they are so adorable.

It might be more interesting, however, to consider the intelligence of the dog. Because their brains are not really all that large, nor do they have the 'advanced' folded brain structures of dolphins or elephants. Yet in some ways they are the most intelligent animals of all.

And of all the breeds of dogs, border collies seem to be the most amazing. Capable of incredibly complicated herding abilities, they also have a look about them that makes you think that they could well beat you at chess. One, named Chaser, was taught the names of over a thousand items, any one of which she could go pick out of a pile. Not only that, but if given the name for an item which she was previously unaware of, by process of elimination she could figure out which item in the pile it was. She was also able to connect nouns with verbs.

Dogs also cannot be beat at so called social-cognitive skills. That is to say, they can pick up on visual and other cues from people much more subtly and rapidly than can any other animals. Or even young humans. Of course, having interacted with us for thousands of years has no doubt helped in all this. But it also raises the intriguing question of how much latent intelligence might reside in all sorts of other wild animals.

Finally, there are the great apes: Chimpanzees, gorillas, and orangutans. But at this point you probably don't need convincing evidence for their intelligence. Nor do you require well researched anecdotes or studies which prove that they have distinctive personalities. You take both things for granted. But that's my point in all this. Because, as I was just discussing, fifty short years ago a 'proper' scientist would have rejected these ideas. But now it is well recognized that even roundworms have different 'personalities'. (Meaning that if a bright light or unknown object is placed in their path, some roundworms will scurry away and others will come close to examine it.)

So a sort of circle has been closed. First, common sense and common observation had long concluded that 'lower' animals still had a certain level of intelligence and personality. Then, because of its belief in a materialistic, utilitarian Universe, an ideologically driven scientific establishment had

declared such ideas to be foolish and backwards. Finally, a mountain of research finally convinced everyone that the 'classical' understanding had been right all along.

But another way of thinking which is derived from these Age of Enlightenment beliefs still exists. And the belated admission of animal intelligence and personality by the scientific establishment has only served to reinforce it.

This is that 'nothing special is going on here' frame of mind which I have already suggested is behind the overly enthusiastic belief in habitable exoplanets and the supposed easy proliferation and evolution of life. One even reads works by biologists in which the existence of humans is treated as some irrelevant sideshow. After all, from a sponge's point of view we're not any big deal.

Except that, of course, a sponge doesn't have a point of view. It's a *sponge*.

This biologists' outlook does admit that, yes, we may be smarter than, say, chimpanzees. But it goes on to say that this difference is only one of scale, not one of kind. After all, chimps use tools when they dig into termite mounds with sticks. They use language when they communicate with one another with commonly understood grunts and chatter. They even have the rudiments of culture, since different chimp troops have different styles and 'customs'. In the end chimps and humans share 98% of their DNA, and are thus only somewhat different versions of the great ape lineage. Cousins really.

Biologically speaking, once again, nothing much going on around here.

But the truth is that what's going on with us humans *is* a big deal. A huge deal. Because the biological reality is that, putting aside the octopus (because we really don't know what's going on in their heads and arms), the rest of the animals that I've discussed are all roughly of the same intelligence. Which is really fascinating when you realize that their various family lineages split off from one another millions and millions of years ago. Indeed with birds, which are direct descendants of the dinosaurs, that divergence happened upwards of a hundred million years ago. Which means that the various intelligences of the various smart animals evolved totally independently from one another.

And yet they have all ended at approximately the same point.

That is to say, elephants and dolphins and parrots and dogs have different strengths and weaknesses, but their general all around intelligence seems to be about the same. And if you happen to think that the great apes are somehow smarter than the rest of those animals, as a mental exercise imagine a chimpanzee trying to herd a bunch of sheep. Or remembering where it had hid a thousand different items.

But, whether or not we have become as smart and as conscious as a species can get, the plain fact is that homo sapiens has taken intelligence a ridiculously giant leap forward from all those other animals. Poking a stick into a termite mound is orders of magnitude different from sending a rocket four billion miles so that it can precisely skim past the surface of Pluto. Having different warning sounds for 'snake' and 'jaguar' is orders of magnitude different from the poetry of Shakespeare or Yeats. To pretend otherwise is the worst sort of sophomoric sophistry.

In fact, were it not for our ideological blinders one would think that by now it should be obvious to all that by now we have more than enough accumulated information so as to close another circle and go back to the received wisdom that all Classical societies had concluded before the Age of Enlightenment. Namely, that Nature is indeed strange and wonderful. But that human intelligence has taken it all to a whole other level. Because now we know for sure that bacteria just sat there for two billion years before complex cells happened. And then single complex cells just sat there for another billion years before multicellular life developed. Finally, animal life just more or less dumbly went around eating and being eaten for five hundred million years. Then about three hundred thousand years ago we homo sapiens came along. And we only got beyond the Paleolithic about ten thousand years ago. We only became literate about five thousand years ago. Five hundred years ago we still knew virtually nothing about modern science. Five years ago we sent that rocket precisely past Pluto.

All of this in less than a pinprick, less than an eyeblink of geological time.

And if that ain’t something that’s more than remarkable, then you tell me what is.

But although we still don't really have a clue as to the trigger that set off multicellular animal life those 540 million years ago, we do have a fairly decent understanding as to the trigger that made it possible for our intelligence to 'explode' so quickly. Or I should say triggers. Because it turns out that there were a whole series of giant leaps forward, basically starting around three million years ago, and then greatly accelerating as we get closer to the present.

So let's start with those opposable thumbs.

Now some other animals, such as pandas and opossums, do have a sort of opposable thumb, which means that they can grasp objects much better than those animals which don't. Most Old World monkeys and apes also have pretty decent opposable thumbs (although chimps don't), which makes sense, since such an adaptation makes climbing and handling fruit a lot easier. (In fact, if it weren't for trees and the primates which evolved to live in them, it's not very likely that our extremely useful hands

would have developed. Which makes you wonder about the nature of the trees on those planets where all those hypothetical UFO aliens evolved...)

Anyway, the thumbs on humans are much, much more sophisticated than on other animals. Uniquely to us, the tops of our thumbs can meet squarely against the tops of each of our other fingers. To get slightly technical, our thumbs can rotate around their long axis. And this gives us a dexterity which no other animal comes close to sharing. We can therefore both strongly grip a hammer to bang things with and gently grip a pencil to write things with. Clearly, even if it turned out that dolphins and elephants had larger and more intelligent brains than ours, it wouldn't do them all that much good without hands and thumbs.

The first 'modern' thumbs are found in homo habilis, a small and still rather primitive ancestor of ours which roamed East Africa around two million years ago. And although it is hard to tell which came first, it is probably not so coincidental that this was also the first ape that fully mastered the art of walking upright.

Now bipedalism is not unique to humans. Dinosaurs, birds (their lineal descendents), and kangaroos (among others) have all mastered it. But usually a counterbalancing tail is required. Great apes, though, don't have tails. And since they mostly still live in trees (yes, even gorillas continue to climb them), their bipedalism is relatively infrequent and unnatural.

Lucy, the famous a. afarensis fossil from about three million years ago, did truly walk upright. But she also had extremely long arms, which means that she and her kind spent much of their time in trees. And it is still unclear as to why she and her descendents developed bipedalism. Theories include the move to a savannah environment (so that they could stand up and see everything, both predator and prey, better), the ability it gave them to travel more efficiently, and the fact that it freed their arms up to carry food and, later, tools.

But, given that the vast majority of mammals (and their ancestors) have traveled around on four legs for hundreds of millions of years, and given that primates have lived in trees for about forty million years, evolving the skeleton so as to support upright behavior was not the easiest thing to do. The foot had to develop a larger heel and become a flat platform for the body to rest upon, but also needed an arch with which to properly support the body's weight. The hip joints and knee joints had to get larger and more mobile. The legs had to get longer and stronger. Shoulders had to get looser so that arms could swing (and also pick up and throw things). Most importantly, the spine had to get a lot

straighter, but also curve at strategic places so that our relatively gigantic heads would be balanced and facing forward as we perambulated around.

Which brings us to those gigantic heads and our gigantic brains. Because—as we have seen—absolute brain size isn't the sole criterion for our superior intelligence. Nor would its complex folds be of much use if we didn't have freely swinging arms and incredibly dextrous hands. At the same time, though, it's undeniable that our big brain is humanity's most distinguishing feature. After all, chimpanzees may be our genetic cousins, but if your actual cousin had the IQ of a chimp they would have been institutionalized from birth. Because the evolutionary truth of the matter is that our brains are fully three times the size of a chimp's.

This rapid enlargement didn't really start until around two million years ago. Lucy's brain was about the same size as a chimpanzee's. That of homo habilis was only slightly larger. But by the time of the Neanderthal the average brain was actually even larger than it is today.

And even more important to our advancement was the evolution that was going on inside those brains.

Now as we shall continue to see as we continue with the podcast, the present moment is a golden period for finding out about how the brain works. But, as with many other subjects, the more we find out, the more complicated everything becomes. And, since we are still in that moment, many ideas and conclusions are still in flux.

But here are some basics of what we knew even a while back. For not only does the incredibly complex folding that defines the modern brain give it a much larger surface area and hence much larger effective volume, but this folding also greatly expands the number of possible connections between different areas of said brain. Add to this the fact that there are around 200 billion neurons in the brain, and that each neuron is capable of about 1000 synapse connections with other neurons. This takes us up to 200 *trillion* possible neural connections right there.

It's also true that, although our overall brains are three times the size of a chimp's, our prefrontal cortex has grown six times larger. And the prefrontal cortex is associated strongly with personality expression, rationality and decision making, and planning for the future. And each and every one of these traits can be seen as a game changer in itself.

But perhaps the most revolutionary aspect to discuss so far is the development, from basically out of nowhere, of language.

Now you might think that there would have been a smooth evolution, from chattering in monkeys to grunts and pointing in cavemen to the first proto-languages in homo sapiens. After all, if we can teach dogs and gorillas that a certain sound refers to a certain thing, how hard can language be? But it turns out that the question of where language came from is still pretty much a complete mystery, and the problem of its origins is considered one of the hardest ones in science. So much so that the world's most famous linguist, Noam Chomsky, believes that in fact there were no precursors to it, and that the development of language—as with the case of the complex cell—is another one of those incredibly improbable one-off phenomena.

The crux of the matter has to do with what is termed modality independence. This means that a 'rose' is a 'rose', whether the word ‘rose’ is spoken, whether it is signed for a deaf person, or whether it is read on a page. Whatever the means of input, somehow, so long as we understand English, the brain *knows* what a rose is. Our brains have thus made a huge, totally qualitative jump from the primitive forms of communication which are seen in all other animals, including the great apes. Indeed, specific parts of our brains which are intimately associated with language, such as Broca's and Wernicke's areas, are pretty much absent even in other primates.

Then there is syntax, the placement and interrelationships of nouns, verbs, adjectives, etc. Which then expands into grammar and sentence structure. All of which is ridiculously sophisticated in terms of the logic involved and extremely difficult to tease out the origins thereof.

Finally throw in the physical changes which had to occur in order for us to speak. For instance, our tongues are of an unusual size, shape, and placement, which (in concert with our lips) gives us a whole range of precise and different sounds that we can make. We can control our breath much more than can other primates, which allows for even more distinction in sound production. Finally, there is our distinctive and complex larynx.

And the mysteries of language don't end there. For I could go on to discuss how our 'theory of mind'—basically, our understanding that other people think and feel as we do—arose out of relative nowhere. Or how our ability to comprehend symbols (eg '9', '%', 'k') came about. Or the bizarre phenomenon of writing: How in Sam Hill can you even *begin* to decipher all of the strange squiggles on a written page??? Or for that matter understand what the term 'Sam Hill' is supposed to refer to?

Then there is fire. Tools. Pottery. Basic metallurgy. The wheel. And on and on and on.

But I've probably already covered enough by now to give you a pretty good idea of the vast number of triggers involved in the almost instantaneous evolution of what we could call—certainly in comparison to all that came before it—as hyper-intelligence.

Note, however, that all of the triggers out there are only telling us *what* happened. They are not telling us *why* it happened. After all, as we have seen with such totally different creatures as crows, dolphins, dogs and gorillas, Nature seems to have convergently evolved a certain level of intelligence along relatively unconnected lineages.

But that's as far as it ever seemed to get. Until humans and their immediate ancestors came along. Because, seemingly out of nowhere, this sudden explosive evolution of intelligence just… happened.

What's the reason? Was it our move to the open savannah and our becoming meat eating hunters? Was it all the stress brought about by the rapidly changing climates of the Ice Ages? Was it just some random gene mutation which made everything click into place?

Actually—although nothing is yet set in scientific cement—there is a pretty solid hypothesis out there. And, whether or not this turns out to be the real ultimate trigger, it certainly (and conveniently) leads us into our next topic of discussion.

Which—also conveniently—means that this particular episode is now over.

Once again, though, as always, I would like to really thank you for so far having listened.