

The Age of Exploration

Brian R. Spisak

Department of Management and Organization, VU University Amsterdam, Netherlands

Allen E. Grabo

Department of Social and Organizational Psychology, VU University Amsterdam,
Netherlands

Richard D. Arvey

Department of Management and Organization, National University of Singapore, Singapore

Homo is a few million years old and therefore for the vast bulk of our tenure on earth we were something other than sedentary and the word has such an aura of self-congratulation civilized what were we we were hunters and foragers we wandered in small itinerant extended families and our knowledge of the hunter-gatherer lifestyle is due to a few courageous and far-seeing anthropologists who went and lived with the few remaining unto gatherer groups before they were finally and utterly destroyed by civilization the anthropologist from whom I learned the most about hunter-gatherers is actually here with us Richard Lee of the University of Toronto he studied a people the son of the Kalahari Desert in the Republic of Botswana and I want to just give a little flavor about my understanding of our ancestors from Richard lead study of the young son I want you to know I practice before the mirror for about half an hour the first thing that I think is very important is that they are highly technological the technology is wood and stone and domestication of fire technology but it's absolutely technology and there are experts and other people who are not quite as good at the technology but not only are they technological for fun they are technological because their lives depend upon chipping and flaking stone tools back before they they had a little trickle of metal into their economy is very difficult to do and of course they they did it superbly well and the archaeological and anthropological record is clear that we were technologists all the way back to the beginning so the idea that science and technology is something new something unusual something we can even find books that say not really very human is completely backwards technology is if anything the most characteristically human activity although as I'll mention later it is not exclusively a human activity now one very interesting insight I thought is hunter-gather tracking techniques a small group with their bows and poisoned arrows and digging tools and a few other lightweight technological contrivances is following the game they come near a stand of trees they take one close look at the ground immediately they know how many animals went by what their ages and sexes were how long ago they passed this one is lame in the back left foot at the pace they're going we should be able to overtake them in another two hours if we hurry now how do they know all in fact what do they notice in

order to follow the game on which their lives pretty well dependent one thing is a hoofprint different animals have different characteristic shapes of their hooves different sized animals leave different sized hoof prints but the decay of the hoof crater the falling of pebbles in the collapse of the raised rims debris blown into it tells you age and in fact it reminds me of nothing so much as determining ages of planetary surfaces by looking at how fresh the impact craters are.

I think the reason that studying crater in physics seems so natural to us is because we've been doing it for a million years they also know that that herd animals in the hot Sun like to avoid the Sun if there is a shadow on the ground they will deviate from their path to just run through the shadow a little bit well where the shadow is depends on where the Sun is and therefore when you see the deviation you know that there had to be a shadow at that spot when they pass well where in the sky did the Sun have to be in order to cast that shadow oh it was 11 o'clock this morning now I don't claim that every contemporary well there are none but back 10 20 years ago every contemporary kun-sun made a scientific calculation did the trigonometry of the angle of the Sun that's not what it's about this was tradition they each generation taught the next but someone had to have figured it out and that someone had to be a scientist and this is another reminder that we've been scientists and technologists from the beginning now having said that I want to turn to the important and rueful fact that every human culture has considered itself at the center of the universe what's this about well I think it's very straightforward back then in hunter and forager x many modes of modern nocturnal entertainment were unavailable some are available but many were not television was not available so over the dying embers of the campfire people watched the Stars and they did it I imagine for many reasons one it is just dazzling and we today living in polluted under polluted skies and in cities with light pollution have mainly forgotten how gorgeous the night sky can it is not only an aesthetic experience but it elicits unbidden feelings of reverence and awe secondly people made up stories about the stars they invented Rorschach tests up there follow the dots constellations look like a bear to you aughh yes.

I guess it does and then force their children to memorize these absolutely arbitrary patterns I don't see the Bears tailed dad shut up and then myths were invented either before or after so these were visual reminders of stories the bear ate your grandpa something like that was put up in heaven as an example or there was the story first and then people put the Bears up there but beyond that there was something enormous Lee practical that is the stars and they're rising and setting are a great clock and calendar in the sky and in the absence of artificial time pieces that's extremely important because there are certain seasons of the year when the herds are running there are certain seasons of the year when the trees are ripe with nuts or fruit and if you know what those seasons are and you know at the moment is you can prepare and you can also eat now the most superficial examination of the sky shows the stars are rising in the east some of them pass directly overhead and some of them pass on small circles close to the horizon but they all rise in the east they all set in the West and then in the daytime they do something else they somehow go around the bottom of the earth that none of us has ever seen it's flat as a board of course and then the next morning they come up again in East now there's there's absolutely

no doubt from this fact that the stars the planets the Sun and the moon all go around us and we're obviously not moving that we are at the center of the universe it's an observed effect anybody who denies that is there's something wrong with them this is the geocentric conceit now not only did every culture draw this conclusion but I think it's clear that our ancestors took enormous personal satisfaction in it because think about it we are at the center of the universe the center of the universe is surely an important place not only that what other animals what plants make use of the apparent motion of the stars only us therefore the stars have been put there for our benefit and the Sun and the moon are practical objects maybe there was some confusion maybe you know the the old story about the the Persian wise man and philosopher who was asked which is more useful the Sun of the Moon and replied of course the moon because the Sun shines in the daytime when it's light out anyway whereas the moon only shines at night when we need a little light but even when people got things you know a little wrong the centrality of our position was stunning and I I imagine an extraterrestrial visitation of the sort that there is absolutely no evidence for coming upon the earth of course running around the Sun once every year and then listening in on on what people all over the planet are saying and they're saying we're at the center we were important we're special everything goes around us and then I imagine the extraterrestrials thinking of us as I don't know the the planet of the idiots but that's too harsh because there's a resonance here between the most obvious interpretation of absolutely straightforward observational facts that every person can verify for him or herself a resonance between that and our emotional hopes and needs the idea that the universe is made for us not because of any particular merit of ours but just because we're here or just because we're human to me this seems to resonate with the same psychic Wellsprings responsible for the view that our nation is special and the center of the universe which by the way is the literal meaning of the Middle Kingdom for centuries applied by the Chinese to China and even those who haven't made it that explicit nationalists of all stripes you can see it by the way in the maps how often each nation has its self at the center of the map and other nations look at it as extreme peculiar to to see Peru at the center of the map what's it doing there it's weird and the same psychic well Springs that say that our gender or our ethnic group or our particular melanin content in the skin or a particular language or headdress or clothing styles or convention of pulling out the handkerchief when we sneeze or anything is important and central and all those alternative ways of being human are somehow less sensual less important less worthy than we are we have a weakness and scientists are creatures of the culture in which they swim and which they have grown up and so we also are vulnerable to this siren song which we can call chauvinism or geocentrism or anthropocentrism so you know the story about what happened next except for a little blip associated with the name of Aristarchus of Samos we went on every human culture every great philosopher every scientist every religious leader thinking we were at the center of the universe we put it in various guises in our scriptures declared the scriptures to be infallible thereby making it not just a secular but a religious crime to even think about the issue until in the late 15th century a astronomer cleric from Poland named Nicholas Copernicus thought he had an alternative idea namely that the Sun was at the center and the earth like the other planets went around it he knew that this was dangerous stuff and so he withheld the publication of his book until he was on his deathbed and even then the way it worked

out when the book was published it had a preface by a well-meaning friend of his Alexander Aussie and ER which essentially said dear reader when you look at this book it may appear that the author is saying that the earth is not at the center of the universe he doesn't really believe that you see this book is for mathematicians if you're not a mathematician close the book I'm paraphrasing slightly mathematicians find that if you wish to know where Jupiter will be two years from next Wednesday you can get a good answer by assuming that the Sun is at the center this is a mere mathematical fiction and it does not challenge our holy faith and please have no emotional angst in reading this book and this peculiar split brain compromise actually lasted for almost two centuries in which people actually said well it's all right it's only for mathematicians the Bible says the earth is at the center we all believe that and then as you know Galileo made a forthright and brilliant defense of Copernicus based in part on a set of observations from the newly invented astronomical telescope and the church got increasingly annoyed Galileo remained obdurate I once had the pleasure at the behest of Franco Puccini director of the art Chhetri Observatory who is also with us here today to actually trod in Galileo's footsteps and hold a close replica of his telescope in any case when Galileo became too insistent the princes of the church showed him the instruments of torture in the dungeons there weren't making any particular point just thought he'd like to see them and shortly thereafter Galileo made his famous confession in which he observed the abominable doctrine that the son enough the earth was at the center but the stage had been set the debate went on and when in the 18th century Bradley discovered the aberration of light and then in the 19th century the long-sought annual parallax was found the the opposition collapsed and now everybody has taught that the earth is not at the center of the universe except I think there's a lot of evidence that we are all geo centrists with a heliocentric of venire that's been painted on us think for example about about our language sunrise I was up before sunrise sunset it was a gorgeous sunset but the Sun isn't rising or setting the earth is turning think of how difficult it is for us to simply parse a simple word or phrase which conforms to the Copernican perspective Billy be sure to be home be home before the rotation of the earth makes the local horizon a cult the Sun Billy's gone before you're halfway through why isn't there any snappy phrase like sunrise or a sunset in the Copernican context recent opinion polls show that 25% of adult Americans do not know that the earth goes around the Sun and takes a year to do it in China the figure is 70% if you bear in mind that the Copernican perspective got to gets a lot of press in the United States I mean there is NASA there are television programs other than in search of or obscure and erroneous mysteries or whatever it's called we do hear that the Sun is at the center and still a quarter of us have missed it and in China you can see where there isn't a NASA and where the television programs are much less sophisticated a much larger percentage of people have missed it if anything like China is typical it may be that today five centuries after Copernicus most people on this planet still think in their heart of hearts that the earth is at the center so I think congratulations on our insights in deducing or important there's something fantastic and great about human beings there is then actual observation of the circumstances nobody ever thought to look before and then the result is the daunting and disquieting discovery no we're not at the center no we're not important and to my mind many of the key findings of science and much of the modern scientific perspective evolves from debates with that character so let me just try to outline a few a

few examples shortly after Copernicus there were people who said okay okay maybe we're not at the center of the universe maybe the Sun is but we're close to the Sun look we're almost at the Sun so we're almost at the center of the universe it's almost as good well was the Sun at the center of the universe which we can loosely translate as at the center of the Milky Way galaxy well the answer is no we are not at the center where it looks important or at least well-lit instead we are in or at least near an obscure spiral arm 30,000 light-years from the center of the Milky Way galaxy in the galactic boondocks if you were an intergalactic traveler coming into the Milky Way would what would you think of someone that said excuse me captain that's the center of the Milky Way it's true but count out spiral arms with me see there is one there's another one really big and beautiful there's another one then over there you see that somewhat obscure spiral arm well don't exactly in it but just a little out of it see you over there I know it's hard to see take a closer look right right there no no not that one that one see yeah yeah the guys who live on that one say they're at the center of the universe and the entire universe is made for their benefit what would you think of those guys and then suppose you had the information there's not one soul on that planet who thinks otherwise every one of them thinks they're at the center of the universe then there was a moment when it was thought well at least the Milky Way's were in the only galaxy but no that's not the case not only are there other galaxies there may be as many as a hundred billion of them then there was a moment when the Hubble flow was discovered when it was found that the galaxies are all running away from us the more distant galaxies running away the faster as if we had committed some dreadful cosmic social blunder when there were people who breathed the sigh of relief this was this was in the 20s of this century look we're at the center our Galaxy at least we're not at the center of our galaxy okay but our galaxy is at the center of the entire universe and this is based upon a serious misapprehension there is no center to the universe at least in ordinary three-dimensional space and astronomers and any one of these galaxies would see all galaxies would see all the others running away from them in the same way that we do then there was for a long time all through my growing up and undergraduate and graduate school career the the statement there are no other planets there was always that is in no other solar system there was always a nearby star that was suspected to have planets and it never did Barnard's star was for a long time a leading hope and if there are no other planets if life has to arise on planets then there's no other life and there's no other intelligence and so in that sense we're at the center of the universe well one of the one of the things about the age we live in last 15 years is that this chauvinism is in the process of teetering and collapsing because we find that more than half of the nearby young sun-like stars have circumstellar disks of gas and dust extremely like what has been deduced for the birthing grounds of the planets in our solar system the key datum being that the orbital planes of the planets are very largely cope and this was by the way something that Isaac Newton no less thought he could deduce the hand of God from that is God took each planet and threw it in the initial condition all in the same plane but Campton Laplace independently knew better and they used nothing more than Newtonian physics Newton had just missed it that the conservation of angular momentum meant that an irregular spinning contracting cloud would collapse into a disk and the planetary formation would occur in the disk and therefore you had to have collisions assad cope linearity of the orbits of the planets not only

are they're amazingly numerous such circumstances of a planetary system going around a star that must be at the bottom of the list of potential candidates that anyone would have imagined a pulsar named PSR B1509-58 this particular pulsar is something like the size of the Cornell campus it's something like an atomic nucleus the size of the Cornell campus spinning at 10,000 rpm 10,000 revolutions per minute it's a supernova remnant there was a colossal catastrophe that blew off most of the mass of that star and going around it are at least three planets to roughly earth-like mass one roughly lunar mass a little in closer than Mercury Venus and the earth and whether these planets survived the supernova explosion or formed recently out of the supernova debris whichever it is the processes which need to planets look to be very a very broad and general application and the technology is now improving so that in the next 10 20 30 years in other words in the lifetime of most of the students in this audience we ought to have completed comprehensive surveys of the nearest few hundred stars maybe much more than that to see what planetary systems they have so this chauvinism I think we can also chalk off now there's been the view that if we're not there's nothing special about us in space maybe there's something special about us in time we've been put here by the Creator to take care of things stewardship is the very engaging word that is often used who knows what would happen to the environment without us so we we have an obligation to make sure everything goes as God would have wished it the only trouble with this idea while there are several but for me the principal's trouble with this idea is that ninety-nine point nine nine eight percent of the lifetime of the universe from its beginning to now was over before any human appeared on the scene so if we are the caretakers where have we been for most of the time we're supposed to be doing our job we have been terribly lacks I could see that the the chief gardener might be very annoyed with us which in turn might explain a great deal we could not have been put here as caretakers because we have not been taking care a because we weren't here and B because when we have been here we haven't been doing very well either then there was the view that if there is nothing special about our position in space or a position in time there's something special about our motion we have a privileged frame of reference this was the classical absolute motion physics that every great physicist bought into until 1905 Albert Einstein a keen critic of privilege in the social sphere immediately mistrusted the contention that the planet we happen to live on was affixed to an imaginary frame of reference which had special merit with regard to the laws of nature and instead asked what kind of physics would it be if you deduced the same laws of physics no matter what planet you lived on what star you lived on it and that is one approach to special relativity which is repeatedly confirmed and is the way the universe is put together another chauvinism biting the dust now this is a set of what any dream has called the great demotions and there are people who find it very upsetting whose still long to be at the center and one area where you can see the emotions not hidden but written out in clear is in special creation the notion that we are the particular objects of the devotion of the creator of the universe that we're different from the other animals never want plants not just in degree but in kind and you know the list no one else has altruism compassion no other animal loves their young nobody else can foresee the future consequences of present actions nobody else says art or music nobody else can use tools nobody else can make tools and this list it goes on and on it is essentially agreed to by Plato Aristotle St. Augustine St.

Thomas Aquinas Hobbes Locke all the great figures in philosophy with a single exception of David Hume hats off to him bought into by all scientists including highly skeptical ones up until the year 1859 bought into of course by all the religious leaders of at least the Western religions especially the judeo-christian Islamic religion and in 1859 Charles Darwin made the first and heroic effort at pricking this blue showing that one species could in fact evolve by absolutely natural processes without any thing for ordained from another species and then when he got up the courage it took a great deal of it more than a decade later he published his second book on the subject suggesting not only does it apply to lots of species but us too we and the chimps have a common ancestor they're our cousin's this contention really makes a lot of people upset have you been to a zoo lately have you looked at what a chimpanzee does maybe you're related to chimps buddy but I'm not well we can learn about chimp behavior in zoos about as well as we can learn about human behavior in jails and for exactly the same reasons they don't bring out the best in us but when people like Jane Goodall devote themselves to observing chimpanzees in their natural habitats the chimps get used to them the chimps have no trouble recognizing after a while that the humans are somewhat inept chimps then we find very different behavior and I can't resist telling the story of gays at - Leakey a anthropologist and animal behaviorist who wished to learn chimpanzee technology particularly the termite fishing industry in which they are adept and so he apprenticed himself for nine months to a chimp named Leakey who was expert now the chimpanzee termite fishing industry goes as follows you find a read not any kind of read the right kind of read you strip it of supernumerary branches feel that it's right and then go to the enormous termite mound now each night the termites cover over the entrances to their nests the chimp takes one look scratches away to three places where the the entryways have been walled up takes the the reed or grass stem and one deft motion puts it down into the termite mound gives a few twists carefully pulls it out the thing is covered with termites the attempt goes and here is a good source of protein now if a human were dropped down in this same place and had a need of protein this source is unavailable to humans tell.

Leakey spending full time on this problem for months could a not break off the right kind of read in fact had to use the leftovers that chimps had picked out could not after nine months find the openings to the apertures that the chimp takes one look at and opens up could not put it down deftly would do that and the thing would come out accordioned could not wiggle it enticingly to get the termites on and could not withdraw without scraping off almost all the termites the end of nine months he'd come up with one termite per chimps know how to do stuff and how do young chimps know to do what gays atelic he doesn't did not learn how to do they were apprenticed for years by the way into like he's wonderful paper in the acknowledgments he thanks his patient tutor and apologizes for his failures because they are not the fault of the being he was apprenticed to it's just humans aren't very good at this stuff there is in fact a bonobo a kind of chimp who lives in Atlanta who not only knows how to use stone tools but knows how to make stone tools this source of human pride is again misplaced now of course there are differences between chimps and us and we have no electric light bulbs and police cars CD players nuclear weapons all sorts of things that chimps don't have but we can't say that they don't have any technology and when it

became possible in the late 19th century to do DNA based sequencing you could get a quantitative measure of the relationship between humans and chimps and it turns out that the two species share ninety nine point six percent of their active genes so one way to look at that is zero point four percent is a much larger number than we had guessed and another way to look at that is you want to know about us take a look at chimps there's a lot there to learn in any case the idea of special creation is really an idea for another time if nothing else but the molecular biological evidence were available it would be very clear that there is nothing in us that is qualitatively different from our nearest chimpanzee relatives that then takes us to the present stands where where these great chauvinism battles are taking place one is the search for extraterrestrial intelligence we have not found life much less intelligence anywhere else yet we send spacecraft to other planets to look for life we construct large radio telescopes and listen if anyone is sending us a message lately both of these activities have led to occasional tantalizing data but none of it of a sufficient quality to say that we've detected life or intelligence elsewhere in our ignorant the geocentric find hope they confuse absence of evidence with evidence of absence you haven't found life elsewhere there isn't any we're the only living creatures on the planet on in the universe on this planet you haven't found intelligence elsewhere there isn't any elsewhere it's only here we are at the center of the intellectual cosmos and while I could give you what I consider to be a strong plausibility argument why this conceit is also erroneous it's only fair to say that nobody knows the answer to this issue we have not found life or intelligence elsewhere we're in the course of looking maybe we will find it tomorrow maybe it will take centuries maybe we will never find it and all we have to do is keep an open mind this no other approach you don't have to make up your mind in the absence of evidence and then finally there is a new and to my mind bizarre field for this debate something called the anthropic principle which it would be much better called the anthropocentrism which comes in strong weak and various shades of middling flavors the weak anthropic principle says if the laws of nature and the fundamental constants of nature was significantly different then the paths which led to us would have been different and we wouldn't be here that is unexceptional certainly true no problem but then there is a strong anthropic principle which to my mind is dangerously close to the following argument we would not be here if the laws of nature and the values of the physical constants were other than they are therefore the laws of nature and the physical constants are as they are in order for the universe to produce us God had us in mind at the time the universe was made and here we are back at the center of the universe again there are many things which can be said about this including the the point that Philip Morrison among others is made that who has traced through what other laws of nature and physical constants will lead to the functional equivalence of life and intelligence it's impossible to do you can also argue against it that it is not very vulnerable to experimental investigation but I would just like to point out that there's something telling about calling it the anthropic principle because the same laws of nature and the same physical constants are required to make a rock as to make a person why is it not called the lithic principle so there's a strong and weak lithic principle and in the strong lithic principle the laws of nature and the physical constants are as they are so rocks could come into being not nearly as satisfying right but if rocks could philosophize I bet you we would hear nothing of the anthropic principle and at the cutting edge of rock philosophy would be the lithic

principle I have only two slides if I can show the first one please this is a absolutely typical astronomical photograph of what's called a star field now focus is important please up one right through it that's pretty good ooh back a little yeah good now take a look up here what you are looking at is some.

I'm not sure ten thousand stars something like that one in front of another so that they seem so closely packed that from a greater distance or with a smaller aperture telescope you could not even tell they are individual stars this is what the Milky Way is it stars in line of sight so closely packed that it looks like a continuum of light many of these stars are more or less like the Sun as I was saying before it now looks as if planets are a frequent if not invariable accompaniment of star formation and again I ask you to consider the contention that the only life and intelligence in the universe is let's say that dot no not that one that one right there see that's it nowhere else maybe hard to extrapolate from one example and one example is all we have but this is so resonant with the other human conceits I tried to outline in the great demotions that i am suspicious of it for that reason alone lights please i want to conclude with one of the many psychic rewards that planetary exploration has brought as brought to me as ed stone outlined in his talk this morning there was a moment when the two Voyager spacecraft had completed their close-up reconnaissance of the Jupiter Saturn Uranus and Neptune systems no other planets that we were going to run David with further out in the solar system it was now possible to turn the cameras close to the Sun and if the worst happened and we burnt out the optics so what there was nothing else we were than a photograph because I had wanted from the time of the Saturn encounter to take a picture of the earth from that remote vantage point and at the same time I want us to get to URIs and neptune and see see what was there and the spacecraft phenomenally outperformed its design specifications and our the bulk of our knowledge of the outer solar system has come because JPL did such a brilliant job with these extraordinary spacecraft coming in on time under cost and of vastly exceeding the fundus topos of their designers anyway as ed well knows it was by no means easy even though the downside was almost nil to turn the cameras back it required an actual intervention by the NASA Administrator to get it done but it was not now it was clear that because the picture Voyager one picture was taken from beyond the orbit of Neptune that the earth would appear only as a single picture element a single pixel you would not even see continents you could not tell any detail I still thought it would be useful to do in the same sense that the Great Frame filling Apollo 17 picture of the whole earth has become a kind of icon of our age because it said something very powerful to us including the fact that from that perspective national boundaries were not in evidence well these pictures were taken in part due to the excellent estimates of exposure times by Carolyn Porco and I'd like to show you in the last slide juda motion the earth momentarily no chauvinistic implications this is just foreground optics the earth in a sun mean wait a little bit that it's not in the Sunbeam so there it is I mean take a look it's a pale blue dot that's us that's home that's where we are on it everybody you love everybody you know everybody you've ever heard of lived out their days they're the aggregate of all our joy and suffering thousands of confident are dolla.

G's religions economic doctrines every hunter and forager every hero and coward every creator and destroyer of civilization every King and peasant every young couple in love

every hopeful child every mother and father every inventor and Explorer every revered teacher of morals every corrupt politician every uncorrupt politician to every superstar every Supreme Leader every saint and sinner in the history of our species lived there the earth is a very small stage in a great cosmic arena think of the rivers of blood spilled by all those generals and emperors presidents and prime ministers party leaders so that in glory and triumph they could become the momentary masters of the corner of a dot think of the endless cruelties visited by the inhabitants of one part of the dot on the scarcely distinguishable inhabitants of another part of the dot how frequent their misunderstandings how eager they are to kill one another how fervent their hatreds our posturings our imagined self-importance the delusion that we have some privileged position in the universe seem to me challenged by this point of pale light our planet is a lonely speck in the great enveloping cosmic dark in our obscurity in all this vastness there is no hint that there's anyone who will come and save us from ourselves that will happen only if we do it it's been said that astronomy is a humbling experience and I would add character building to me this is one of many demonstrations through astronomy of the folly of human conceits to me this picture underscore is our responsibility to deal more kindly with one another and to preserve and cherish the pale blue dot the only home we've ever known thank you.

Thank You Carl for a great speech I'm already looking forward to your 70th birthday professor Sagan will answer questions for a while if there are microphones and the aisles if you could come to the microphone that will make it much easier.

he'll feel the questions himself Thank You Dale I'd be glad to answer questions on anything we've been we anything I've been talking about or anything else that's on your mind I don't promise to be able to answer anything everything but I'd be glad to give it a shot professor James Henderson is not asking a question but merely taking a picture yes please yes please you'd like to know two things first one is who said billions and billions that I can answer very quickly it's someone named Johnny Carson I never said it I never ever said off-the-hook everybody I mean it's sort of like Humphrey Bogart never said play it again Sam nobody believes it but it's elementary my dear Watson it's Elementary it's elementary my dear Watson is another in in the movies he says it Basil Rathbone says it but in the Arthur Conan Doyle books he never says it yes and you're second okay so we also want to know what if any one thing in particular would you have yourself be remembered by you know I hate the the one only kind of question you know what's your favorite scientist or what's the greatest discovery in the history of the world I don't know I I have to leave the decision about how I'm gonna be remembered which I hope will not have to be faced for some time to to others but thanks very much for the other question yes I was interested in your great demotions and I certainly speak more into them I certainly let's say agree in certain most ways with what you say where among the great demotions would you fit in or would you fit in at all the appearance of consciousness among humans yes that's that's an important question I'll repeat it because our voice while lovely is very soft the question is what about the evolution of consciousness isn't this another of the conceits that only humans are conscious I'm paraphrasing but would I include that in the ended emotions any drian and I wrote wrote a book called shadows of forgotten ancestors in which we tried systematically to look at each of these what I've called conceits and I think the most startling thing we've learned or speak

for myself that I learned in the course of doing that book was how we kept getting it wrong on these issues no consciousness has various meanings if it means an awareness of the external world and modifying your behavior to take account of the external world then I think microbes are conscious if you mean deep thoughts like Bishop Barclays contention that nothing exists except what's in his mind I'm with the microbes myself you see how do you know that I think any thoughts only because I happen to be communicating to you can't easily tell that I have philosophical thoughts by looking at me drinking this cup of water right so imagine that I was mute that I could not communicate by speech or writing or anything else then how would you know if I had such thoughts the evidence for not just the so-called higher Apes but running through the Apes and the monkeys to me is very persuasive that they have thoughts not only deep philosophical thoughts but useful practical thoughts like lying like deceit like planning to fool others thinking about it far in advance but let me just give one one little image which I like because it covers many different grounds these are the results of work at the Arnhem Colony in the Netherlands where there's a large free roaming community of chimps males are testosterone driven and subject to raging hormonal imbalances they get angry at each other and pick up rocks they go quite a distance to get the rocks in order to confront the guy who they don't like and throw stones the very act of going over there out of sight of the enemy to pick up the stones and then bring them back to throw the stones shows think I had understanding a goal and aware of yourself and the opposition but most interesting thing is it is common for female chimps seeing the male's burdened with their stones to walk up to them and this arm them look the stones out of their arms open up their fingers and throw the stones away and when the males in a huff gather them up the females disarm them again so not only do the males know what they have in mind the females know what they have in mind and that to me not only is consciousness but a social arrangement I'd like to see more of in humans my question is given all these demotions what is your personal religion or what do you is there any type of God to you like is there a purpose given that we're just sitting on this speck in the middle of this sea of stars no I don't want to duck any questions and I'm not gonna duck this one even though I have high religious personages who are close friends of mine in this room but let me ask you what do you mean when you use the word God well I guess what my question it's like is there a purpose for I mean given all these demotions why don't we just below ourselves though why don't we yeah what what is what is our purpose I mean turn the question around if we do blow ourselves up does that disprove the existence of God no I guess not I mean it'll be a little late to make the discovery but still yeah I guess what I what I'm asking is since as we as we kind of make God almost go away in this as as he threw these demotions and I I don't mean he because who knows what God is but but still saying it makes it right icky doesn't yeah yeah it's it's tough I like it to be a yeah don't we yeah we've been trained to think of it as a he it's it seems that through the ages we have humans have created a mythological framework that has always involved some kind of often involves some kind of higher spiritual powers and as every human cultures another as that goes away as we know more and more that and it seems harder and harder to prove that anything might exist like that where does that leave us on our own which to my mind is much more responsible than hoping that someone will save us from ourselves so we don't have to make our best efforts to do it ourselves and if we're wrong and there is someone

who steps in and saves us okay that's alright I'm for that but we you know hedging our bets it's Pascal's bargain run backwards I'll say another word the word God covers an enormous range of different ideas and you recognize that in the question running from an outsized light-skinned male with a long white beard sitting in a throne in the sky and tallying the fall of every sparrow for which there is no evidence to my mind if anybody has some I sure would like to see it too the kind of God that Einstein or Spinoza talked about which is very close to the sum total of the laws of the universe now be crazy to deny that there are laws in the universe and if that's what you want to call God then of course God exists and there all sorts of other nuances there is for example the deist god that many of the founding fathers of this country believed in although it is a secret whose name may not be spoken in some circles a Hawaiian Neyland a do-nothing King the God who creates the universe and then retires and to whom praying to is sort of pointless he's not here he went somewhere else he had other things to do now that's also a God so when you say do you believe in God if I say yes or if I say no you have learned absolutely nothing I guess I'm asking you to define yours if you have one but why would we use a word so ambiguous that means so many different things it gives you freedom to my fine you freedom to seem to agree with someone else with whom you do not agree it covers over differences it makes for social lubrication but it is not an aid to truth in my view and therefore I think we need much sharper language when we ask these questions sorry to take so long and answering this but this is a important issue hi me and some of the other students here at Cornell were wondering about your your house was it was it some kind of power plant or what power plant what was it over it was your house right good I guess what I said I try to answer questions even that aren't related to what I talked about I really I really let myself in for it okay that is a study that Annie and I work in and where we like it was a long time ago the headquarters of the Cornell Spinks head Society in which God knows what abominable rites were performed but I can assure you these days it is extremely Placid and Eddie says she's not so sure anyway it's it's very benign whatever its early history which goes back to I think 1892 may have made it also was once a sculpture studio of a remarkable Cornell professor designer of nuclear accelerators and the sculptor par excellence named Bob Wilson yes yeah I want to know what your views were on astrology I know it's a related science astronomy what on astrology exercise all Egyptians what's excuse me it's a hoax hoax HOAs Oh what about okay what about the document improved Sagan what about document improved from studies were well let me clear voice you told that's different that's different right right okay well that serology is different from me okay nervous sorry I confuse it to about no I'm happy to answer clear extrasensory perception right Canisius do they exist and just everybody do certain individuals have and how did it arrive em if this is it exists it would have arised by evolution a natural selection the same way as everything else well why don't we mean by extrasensory perception there is a African freshwater fish that establishes static electric fields and then detects its prey by perturbations in the electric field we can't do that at all doesn't correspond to any of our senses does this fish have ESP in a sense yes fine okay if it does have ESP is this mysterious is it a challenge to science or is it just another way of perceiving the world it's it's a different way of perceiving the world yeah so therefore if there is ESP I think the chances are excellent that that it can be well understood by science but to the best of my knowledge there isn't any ESP yes hi I like first of all to say that it must

be a true privilege to be able to develop a career something as stimulating intellectually and spiritually as astronomy.

now my question to you is what's your opinion on the use of animals in biomedical research on what the use of an animal's environment of animals right.

I I have struggled greatly with this issue in part because I have a graduate student Peter Wilson who holds my feet to the fire on this issue for example I have a 20 year old leather jacket that I used to wear to Cornell that I don't wear anymore I do wear it around the house if truth be told I am very conflicted on this issue that gratuitous pain should not be inflicted on other animals or for that matter plant I think is clear and that animals should not be made to suffer for fairly trivial goals the making of lipstick for example I think is clear to argue though that animals should not be used in the pursuit of medicines and medical procedures that might save the lives of humans is not so clear to me and Charles Darwin had just the same distinction he was way ahead of his time and an opposing gratuitous pain but it would also not argue that no animal experiments should be done and I think if I had to if I had to explain somehow it was my job to do so to some people whose child was dying because a medical procedure was unavailable which might very well have been available with animal experimentation have been performed I don't know how I would do that justification now you might say to me that I'm putting humans higher than other animals and where do I come off doing that especially at the end of an evening where I've been decrying chauvinism this to me is like the argument that is sometimes said Dave Morrison mentioned it in his talk today why should we take any steps to save ourselves if an asteroid is going to hit the earth since asteroids have hit the earth in the past and you know others have gone so we might be here so we'll go so you know whatever it is the raccoons will have their chance or the answer the sulfur oxidation state altering submarine worms will inherit the earth at this point I have no difficulty in since I happened to be it's an accident of birth a human being to justify human beings trying to survive under sometimes trying circumstances that's my judgment I'm sure if you know I were a lizard up here I would be talking about yes let's sacrifice the human so we can get better medicine for the lizards after all I'm a lizard I'm sorry I can't help it I'm human I'm not saying this as if I know what your point of view is but but I'm just trying to clarify how I how I think about it my first I could say happy birthday professor Sagan I'm sorry I didn't get you a present now there are various structures in the Andes and also formations and crops in northern England which people say are results of extraterrestrial and the variants or appearances but now reasons the plains of Muscat yes in AZ SIA I was just wondering about your views it is whether or not we actually have been landed upon and yep well one way to look at this is May first of all what is on where did all this stuff about the plains of Nazca being somehow mysterious and extraterrestrial come from it came from a guy named Erich von däniken a Swiss hotel guy who wrote a book called Chariots of the Gods which became a worldwide best-seller in which he argued as follows on the plains of Nazca in Peru there are large drawings some of them look like spiders some look like turkeys some are straight lines von Daniken concluded that the straight lines were airfields and the other stuff was messages that doltish humans were instructed in carving in the desert of Peru by extraterrestrial overseers why what's this about we don't know how to draw big pictures without extraterrestrials telling us what to

do some of those straight lines are six inches across how big are the airplanes that land on those airfields what are we to imagine an interstellar spacecraft effortlessly crosses hundreds thousands of light-years the cargo door is open and out come little propeller driven airplanes about that size like likelike my three and a half year old son plays with and they they land in Peru and help me we we got toy airplanes please make airports for us and by the way make a big turkey this is silly the the common feature in all of von Daniken's fantasizing is that he sells our ancestors short he goes to Egypt he sees pyramids boy those are big how big are the Constituent blocks 100 tons hundred tons von daniken I couldn't live a block that weighed half that therefore human beings are unable to lift blocks of that mass therefore extraterrestrials did it QED but if he had read Herodotus nevermind archaeology this Hirata is written you know it's an English translation in German translation we have an idea about quarries and logs as rollers and rafts up the Nile and how humans could do it we're perfectly capable of building things big even those of us who lived a long time ago even those of us with dark-skinned people know how to build big and the the idea of extraterrestrial visitation is required every time a naive observer can't figure out how something could be done is silly the one possible positive aspect of von Daniken is that it might in frustration drive an occasional reader into archaeology.

thank you uh happy birthday Abdi honest with you a friend of mine mountain acquaintances of mine sold me the idea that Steven Spielberg was gonna be here so that's why I came what look really Harry I'm at first I heard of it I I'm awfully sorry that you did I know but if I'm glad I came because when you were doing all that thing about pointing out where earth is and how you know little we are and compared to the universe wouldn't it be easier for man for man for men women the visual manage and Hillman's you know humans okay for humans who think that we're not the center of the universe if we have all this now dad it would be I mean it's easier now what why can't we believe like the hard the challenge now is to think that we are at some way and some and somehow the center of the universe in some kind of way not not physically that intellectually but somehow there I don't want to make it like of a purpose but so as you do okay that's a purpose but no but you know it's now easier for us to believe okay it's easier we can put our mind at rest but somehow are we are we closing her mind aren't we closing by not saying that we're not in some way they sent through the universe but imagine that you're an octopus okay okay what about organisms are not on the center of the universe okay.

I'll change it not I mean humans because we could communicate understand each other I'm just saying it cuz you know but I'm saying that you organisms my mind is open you come up with evidence we're at the center of the universe I will gladly confess defeat hello first of all I'd like to say I'm glad I didn't get to ask my first question about God and I left it to him but my second question and which might be oversimplified is if every matter has an antimatter and the Big Bang Theory created the universe which is supposedly the matter where is the antimatter in the Big Bang Theory there is quite sophisticated cosmological speculation and theory on this clearly if there's an an excess of one over the other and the universe is well mixed then since matter and antimatter annihilate each other which ever had my good friend the emeritus everything the America dismiss er suggests that it's time to come to an end let me take Dale if I may one or two more questions and then and do you think that

we're now is demoted as we can get or don't think that that kink then can you see what further humiliations can you see for us in the near future doctor wing asked what further demotions humiliations do I foresee for us you see the idea that our sense of self-worth comes not from anything that we've done not from anything worthy but by an accident of birth is where the crux of the humiliation is in my opinion I would say those of us worried about being demoted.

those of us who wish for us to be important should do something important.

we should make a an easily understandable achievable and inspiring goal for the human species and then set out and do it that would give us the confidence that we sorely lack by being dependent on our self-esteem being based on nothing we do we want to have self-esteem let's make a planet in which nobody is starving let's make a planet in which men and women have equal access to power let us make a planet in which no ethnic group has it over another ethnic group let's have a planet in which science and engineering is used for the benefit of everybody on the planet and my personal idiosyncrasy let's have a world in which we go to other worlds.



References

- Castro, V., 2011. Can central banks' monetary policy be described by a linear (augmented) Taylor rule or by a nonlinear rule?. *Journal of Financial Stability*, pp. 228-246.
- Chang H, Dong X, MacPhail F. Labor migration and time use patterns of the left-behind children and elderly in rural China. *World Development*, 2011.
- Datta, D., & Ganguli, S. K. (2014). Political connection and firm value: an Indian perspective. *South Asian Journal of Global Business Research*, 3(2), 170–189. doi: 10.1108/sajgbr-03-2013-0020.
- Döpke, J., & Pierdzioch, C. (2006). Politics and the stock market: Evidence from Germany. *European Journal of Vuchelen, J. (2003). Electoral systems and the effects of political events on the stock market: The Belgian case. Economics and Politics*, 15(1), 85–102. doi: 10.1111/1468-0343.00116.
- Economic Impact of Covid-19 on Different Sectors of Indian Economy. *PRAGATI : Journal of Indian Economy* 7, no. 2 (2020). doi:10.17492/jpi.pragati.v7i2.722021.
- Enders, W. (2004) *Applied Econometric Time Series*, 2nd Edition. In: *Wiley Series in Probability and Statistics*, John Wiley & Sons, Inc., Hoboken.
- Esin, C. and Gupta, R., 2017. Does the US. macroeconomic news make the south african stock market riskier?. *The Journal of Developing Areas*, 51(4), pp.15-27.
- Ewing, B. T., Forbes, S.M. and Payne, J.E. 2003. The effects of macroeconomic shocks on Sector-specific returns. *Applied Economics*.
- Franck, P., & Young, A. (1972), Stock price reaction of multinational firms to exchange realignments, *Financial Management*, Vol. 1, No. 3, pp. 66-73.
- Johansen, S. (1988). *Statistical Analysis of Co-integrating Vectors*. *Journal of Economic Dynamics and Control*, 12.
- Joshi, M. (2013). Factors affecting Indian Stock Market. *International Journal of Contemporary Research in Management, Research and Health Sciences*, 2(1).
- Kilian, L. (2008). The Economic Effects of Energy Price Shocks. *Journal of Economic Literature*, 46(4), 871– 909. .
- Martina, C. & Milas, C., 2013. Financial crises and monetary policy: Evidence from the UK. *Journal of Financial Stability*, pp. 654-661.
- Pottinger, A. Children's experience of loss by parental migration in inner-city Jamaica. *American Journal of Orthopsychiatry*, 75(4), 2005.
- Rydberg, H. T., (2000). Realistic Statistical Modelling of Financial Data. *International Statistical Review / Revue Internationale de Statistique*, 68(3), 233. .

Seeborg M C, Jin Z, Zhu Y. The new rural-urban labor mobility in China: Causes and implications, *The Journal of Socio-Economics*, 2000.

Shaw, E. S. (1973), "Financial deepening in economic development", Vol. 270. New York: Oxford University Press.

Shiller, R. 1981. Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review*, pp. 421-426.

Singh, A. Didar. "Reflecting on the Global Economy (and India) through the Lens of COVID19." *Journal of Indian Ocean Studies* 29, no. 1 (2021): 1-10.
doi:10.32381/jios.2021.29.01.1.

Üngör, m., n.d. Estimating the output gap for turkey: a simple production function approach. Central bank of the republic of turkey.

Wen M, Lin D. Child development in rural China: Children left behind by their migrant parents and children of nonmigrant families. *Child development*, 2012.

