How The Brain Creates Mind
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Lecture - 19
Future of Brain-1

Welcome to this last hour of this course, where we were trying to explore the processes of brain, and how it creates mind, and I hope it as serve it is purpose still now, because it took a journey from the very large level of behavior, which kept popping in every now and then. And then we took almost reduction supposed to understand, to microscopic level to mesoscopic level, and to. Not really microscopic, because that would have taken us to universe. So, where does all this live us, just to recapitulate, and give a idea of how putting everything together.

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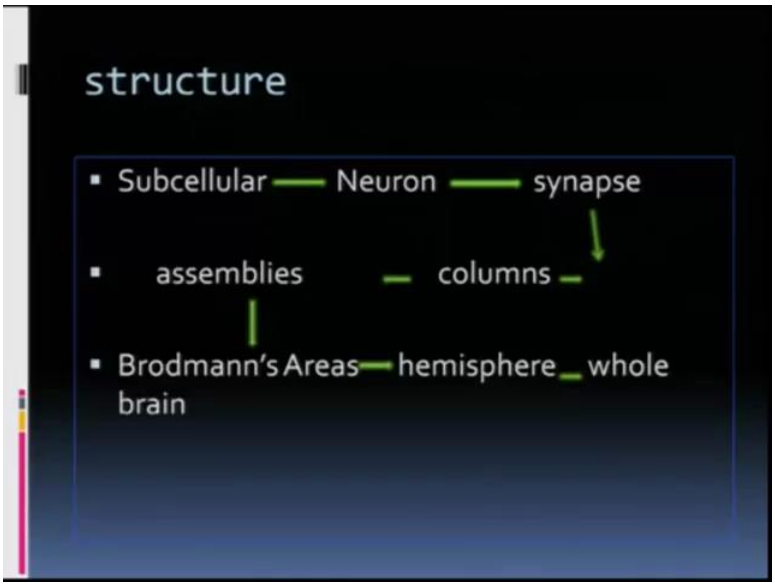

So, look at the structure; sub cellular talking about turbulence, talking about mitochondria, talking about dendrites to neuron, which is a basic unit, right from dendrites to axon, and its neurotransmitter. Sub cellular; obviously, includes the formation of neurotransmitters. is neuron connected to the other through synapses, multiple neurons get organizing in microscope column, mini columns, and micro, columns to functional cell assemblies, the (Refer Time: 01:48) cell assemblies whether they are located in different parts, whether they are separate from each other, but they

connected functionally, neurons that fire together why together, the basic template of learning. To basic brodmann areas, the specialization of speech area of, receptive area of, visual area of, motor area of, sensory area, they go on to make one hemisphere, and two hemisphere is go on to make the whole brain. this the broad structure of brain when we talk about it.

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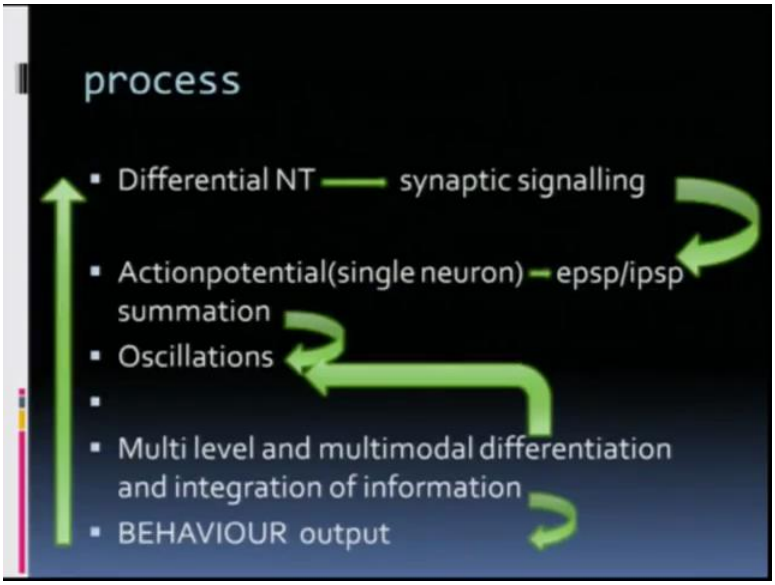

And what is the process; each neuron having neurotransmitters, either a single one of them or the differential of neurotransmitters, while connecting to the other neurons, synaptic signaling in the order of 0.5 milliseconds through neurotransmitters like acetylcholine, norepinephrine, dopamine, glutamate, gaba. Some of them are excitatory, some of them are inhibitory to action potential that sudden firing from minus 70 milli volt threshold of minus 55, and then peak of at a single neuro level, but neurons, a single neuron does not mean anything, it has to sacrifice its history to into the assembly into the multiple odge of neuronal network.

Then the post synaptic potential, the excitatory post synaptic potential, and the inhibitory which submit together. We talked about the (Refer Time: 3:14) modal of it, and half field network, which are based through, which work through associative networking, content based categorization system, and energy transmission, which create oscillations, and we know the oscillations from 0.5 to almost 500, but of our interest what we have is 0.5 to say 40 hertz which a gamma oscillation, the bind oscillation.

So, what we know that there is a multi-level, multi modal differentiation and integration of information. So, the whole purpose of this process is the interface with the external world, with the information is taken, it is process, it is memorize, it is categorized, it used basically for two things, rather one thing first; that is survival, and second is; obviously, you have to these have to perpritate the human rays. So, to survive, you have to anticipate the future, predict the future. So, lot of areas, lot of this information in humans, we do not know about animals. I am sure animals also must be doing it, is about taking the information and going into a mode of anticipation and predicting the future, because of they do not, then you cannot plan and lot of human activity has come out of this anticipation and prediction, and the ultimately the behavior output. As you go from neurotransmitter which is a micro thing, a micro structure, a micro level to complexity of behavior itself, is very complex and so many psychological factors.

So, many things go on, and we have and I am not talking about psychology here, because and this is a entire physical process which I have explained in this two slide, entire physical process we are not talking about the thoughts, the emotions, but they are also simultaneously effecting all this, and all this system have a feedback thing. Behavior can alter the neurotransmitter signal like chemistry, and it can alter synaptic signaling, it can alter the action potential oscillations. So, this is a huge feedback loop reentrant recurrent loops, which keep happening, which lead to what we call live for understanding.

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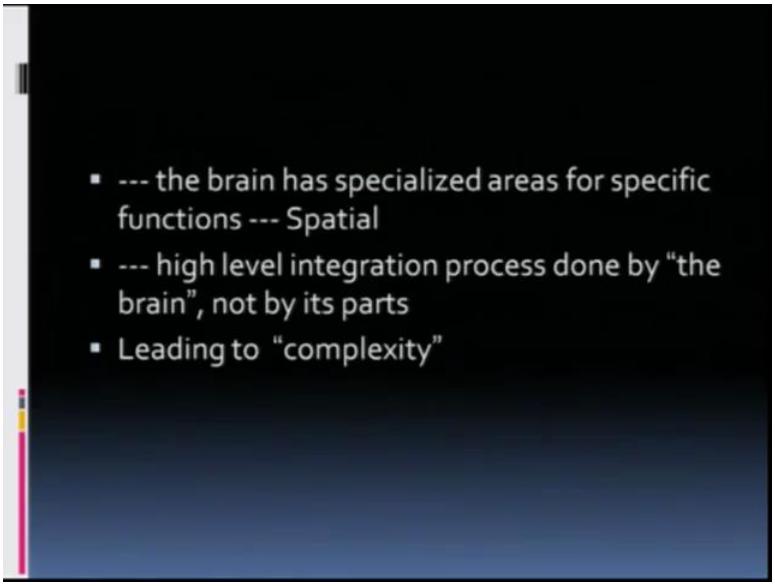

So, what we know that the brain has specialized areas for specific function. So, it is a modular structure, which is the special understanding of brain. It is a high level integration process done by the brain, but not by its parts. Each part is doing its job, is the association areas between this part, which actually create the meaning, whether it is in one area associative area, or it is at a higher level, through the default mode network, through the central executive network, or through the salience network, this various type of network.

Remember, in the first slide we have shown you couple of these networks. The ultimate product is complexity. Human behavior itself is complex, and so is the underlining brain network, so just to retreat it molecular synaptic level.

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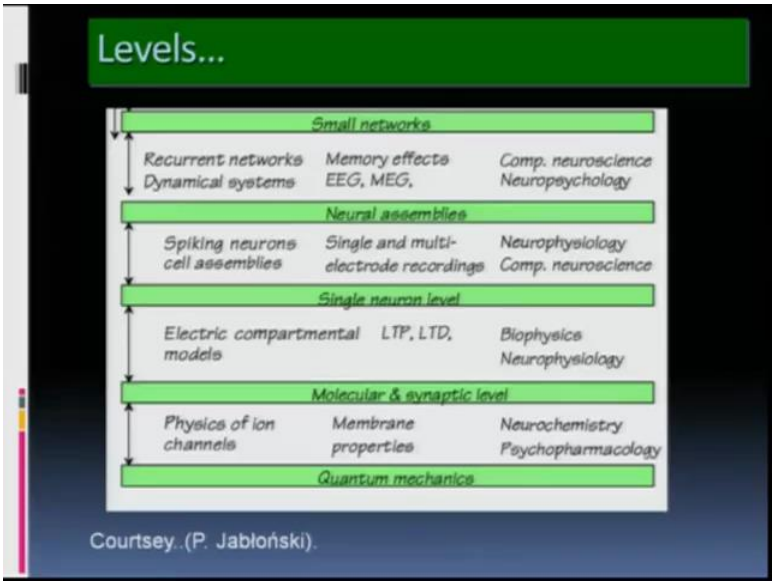

So, at a very molecular level we are talking about ion channel and membrane properties, neurochemistry, psychopharmacology. So, to single neuron level find electric compartmental modal, sodium potassium in flow and out flow, and sodium potassium ATPS, the long term protestation and long term depression, forming memory and forgetting, it is a physics to it neural assembles, the spike of single neuron and multiple neurons. We know about E G, and as you go up talk about EEG and MEG and recurrent networks.

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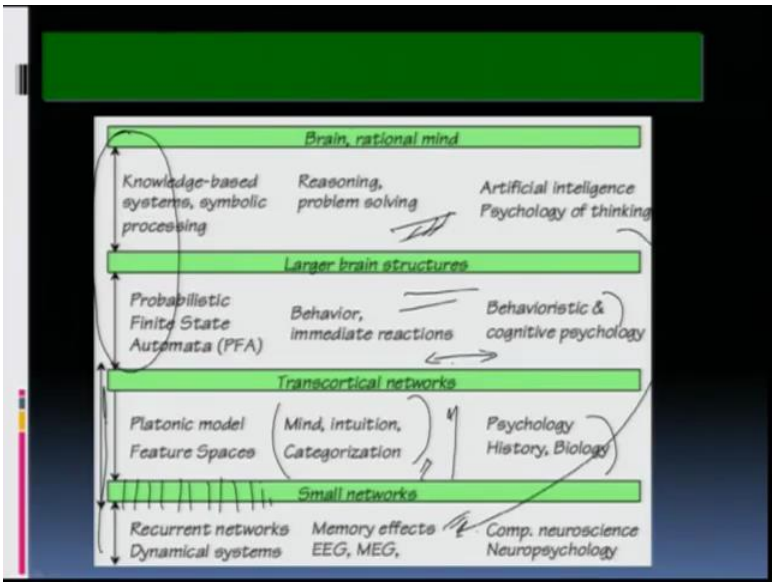

Continuing to that level, then there is a small network where you have recurrent network dynamical systems. Then you have transcortical, across the contexts. Then you go larger brain structure, where you are talking about behavior, and called into psychology. Now, as you see, till a small level here, if you look at it, it is all talking about physicality of the brain. So, it is see this small networks, see this small networks, they all are in feedback loops if you can just look at, see the arrows. So, it is a modular structure, but still it is a parallel processing, and while it is parallel processing, it is still hierarchy.

Because as you go from lower level to higher level the whole complexity is increases, and this all connected. So, in hierarchy, this is wonderful, because too many different concepts are coming modularity, parallel processing. we are not supposed to have hierarchy, but then in parallel processing also you have a hierarchical system, because of the structure, and we are not talking about the geometry of the brains still, whether it is because of the geometry of the brain the (Refer Time: 08:31) the way it is packed. now engineering, from engineering angle it is fine, because you get more space to pack more neurons, you need more neurons to more data, to have more information, but is the geometry of the brain in space and time, is really giving the way it behaves, not only in humans lot of mammals and primates.

The once you cross this transcortical level, you have to talk about, or small networks in that sense, you have to start talking about mind, intuition, psychology, behavioral

psychology, and then that form another abstract layer over the real physical process, that still is the biggest enigma, because the lot of thing which we do not know. a mind can communicate to the mind, telepathy. People can see dreams. We talked about dreams in briefly in the last lecture. what are dreams meant for, why this structure of deep sleep and dream sleep, what is the purpose, we really do not know, we have modal, but still we are very far and then.

So, this layer of abstract thinking has one more layer, where we talk of all psychologies, spirituality, behavior, relationship everything which goes into your life. So, we have huge information, the (Refer Time: 10:05) of information, which has given us pockets of understanding of physicality of the process. We have psychology spirituality philosophy, we should not ignore all this, even while we are talking about science, because vast based of knowledge, we just cannot reject it.

Which explains this abstract cloud of knowledge, or emotionality and all, where is the connection between the physicality and. So, that is the big debate like we talked about consciousness. Some people say physicality till this level, actually gives rise to all this, but this is a big knowledge base system we says that all this is separate. The physical theories cannot really explained that how does this abstract cloud effect the. Agreed that there is a electro chemical signaling, forms a pattern and this pattern gives rise to mind and thought and everything, agreed it can be junk from electro chemical activity to this abstract thing, all thought we do not know, what is the real content of the thought.

Now how does this thought get back and affect this electro chemical firing. It does we know. You may be heard and you have reached somewhere, but you can still put your will to really go there. So, where does this will? does this there is a central brain which have been we do not know. So, the same electro chemical activity creating a will, which is sort of a cloud, if you thing that way, but how do this cloud get back to electro chemical activity, is the big gap. This gap is still. So, we know pockets, where we can lot of utilitarian activity we will discuss about and this as move on.

So, what I wanted to do in this next thirty forty minutes, whatever we have just think. You have to think now, because I am sure if you think some of you may really (Refer Time: 12:06) take it on to the next 50 years of research.

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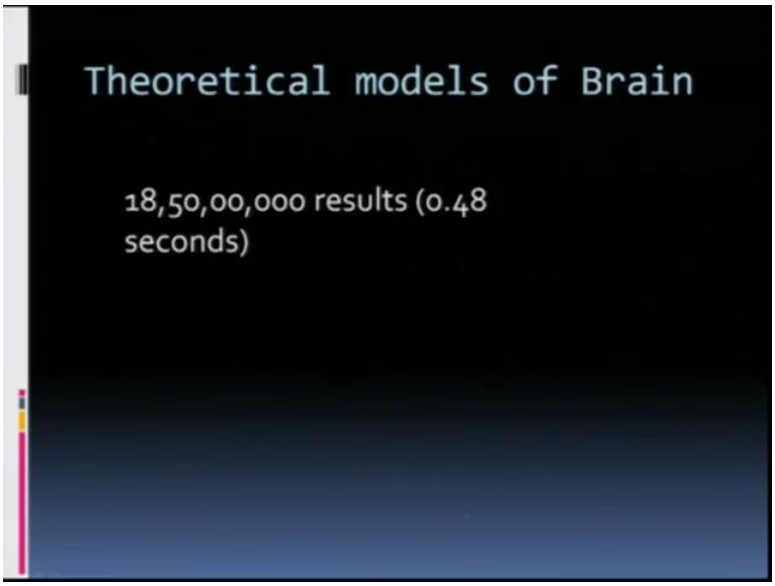

It is a very interesting time in neuro sciences. I just put this theoretical modal of brain on Google today, and these are the results I found it 0.48 seconds. So, you can just imagine the amount of work which is going on. Some of them, this may be repetitive, but still if we look at the basic modals, still they are many. So, what and what has happened, it was biology and psychology which was working still about twenty years back, may be thirty years back. And suddenly people realize that physics and chemistry and computer everything as to get in, because computers are where being modeled in the brain processes, the way brain works, especially with people who work in artificial intelligence. So, what is the physics of brain is the quantum physics.

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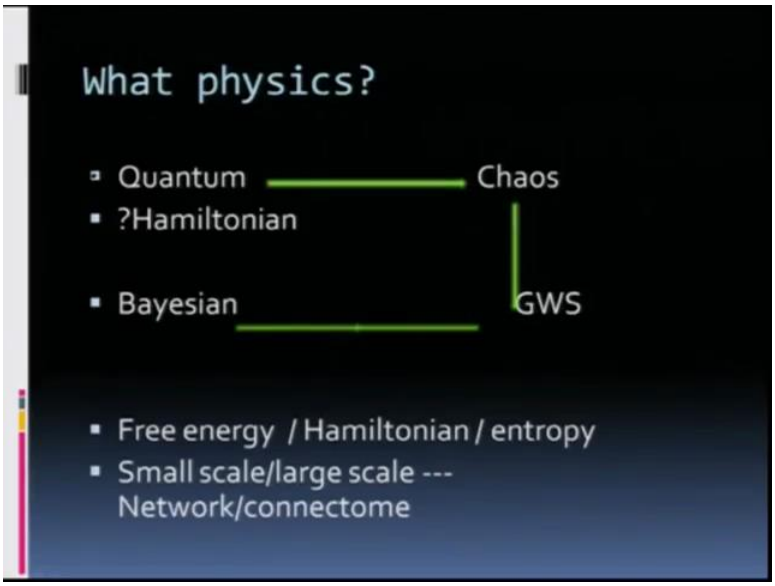

Lot of people worked on this, lot of people are criticizing. I will take few names, may be you can find out the original differences. Roger Penrose is a great mathematician Hawkin's colleague and he written two books shadows of the mind, and (Refer Time: 13:19) find out time to read that (Refer Time: 13:24) they talked about quantum process at the level of micro tube, its sub cellular structure, and the quantum tunneling between the synaptic. People; like max Tegmark, who was written a new book called our mathematical universe, criticize them, because just our time is skilled, we have talked about it (Refer Time: 13:45), they were the people who were talking about the non-linear, very popular around 95 and 2000.

It actually went out of fashion, this quantum coming in, but the non-linear dynamics in the brain is a reality, and these are type of signal analysis which you do. If I get time I will briefly show you what type of signal analysis, because you do all this non-linear thing, dimensional complexity, attractive dimensions, exponents (Refer Time: 14:16) exponents. This type of (Refer Time: 14:19) know, where. see the differences some process are trying to look the basic microscopic, again the scale difference.

Now this the scale thing is a big problem in studying; that is why probably compressive theory is not being able to come out, quantum we are talking about some microscopic scale, non-linear dynamics talking about the whole dimensional complexity of the brain. Then their systems like, with people have studied like Hamiltonian modal of brain. These

are theory by BAARS; B A A R S, he is written a wonderful book, and you can find out it on the net, is called global work space theory.

Remember the picture I have showed you talking about conscious is a huge unconscious, and there is a conscious thing, the whole buffering of sensation and going to central global work in space in the brain, which is arising from the electro chemical activity and the neuronal network, but like work space is like a envelope over the brain, and then the Bayesian probability thing. You know Bayesian property that it uses the present dynamical state to check the probability, to check the possible roots which you can follow. then there are papers on free energy modals, Hamiltonian already told you, entropy, second law thermo dynamics; the brain is a warm structure, it is not a cold structure and it is not fully closed either fully open, but still brain, does brain have a entropy, which may lead to, and at the same time entropy causes disorder, but the brain at the same is very homeostatic organ. It tries to remove ambiguity uncertainties and bring the whole system back to our restring state.

This dynamics disorder and order, then the small scale network theory which has been brought (Refer Time: 16:20) which has been applied to the brain, slightly appears to be small, whether there are larger scale network theory also. So, the thing which is popular these days is brain being studied on networks, graph theory. One of the popular thing is connectomes (Refer Time: 16:40) response. Connectome is a modal which has been given that brain has nodes, like any network they have nodes, and they have edges which is connecting.

So, based on this nodes there is a huge number of modals which are coming up, but again the problem is, when we study all this, either we made a theoretical modal and then try to do experiments, how we do experiment, maybe I make a theoretical modal, of all what is going on a brain in a given instance; however, you going to check it. We again have resort back to small, the microscopic single neuron, does it work. No. Intracortical recording, does it work. No. e g. yes, but e g does not give the special thing. So, MRI is all task dependent, task dependent movement give a task you already restrict, what you call region of interest, again the whole brain is gone. So, that is the big difficulty, of uniting the special temporal in a given instance, and then extrapolating it to whole brain functioning, whole brain functioning is so complex, because each area is doing is different things how do you unite it, then you see the number of papers. So, where do we

stand, let me take you back, many years back, 5000 years back, next to reverse vyas.

You would have heard of Vedas; Rig Veda, Sama Veda, Atharva Veda, Yajur Veda. I think they were very smart people, very smart, but still they would have realized the futility of possession. So, no, we do not know who wrote it they never put their name into it. After writing the whole Rig Veda which is a sort of way life and worship and everything, there is a tenth mandala in Rig Veda and this is something called Nasadiya Sutra. If you really trace history in a very secular form, that is the first skeptical enquiry of existence, and I think cosmology, physics, even quantum physics some extent, and all the neuro science is still groping with this question.

Maybe answers were not there, answers may come from us at our times, but the questions were right. after writing all this we wrote something called Nasadiya Sutra. So, I am just giving you an example, some of you I do not know whether, some of you who were there in 1919 were conscious is enough would have seen Shyam Benegal serial called Discovery of India, if not please get a D V D and see it, and its available on you tube also. It is starts with it [FL] before the creation there was no truth there is no falsity, [FL] what was hidden where. So, just I am translating one of the slokas of it.

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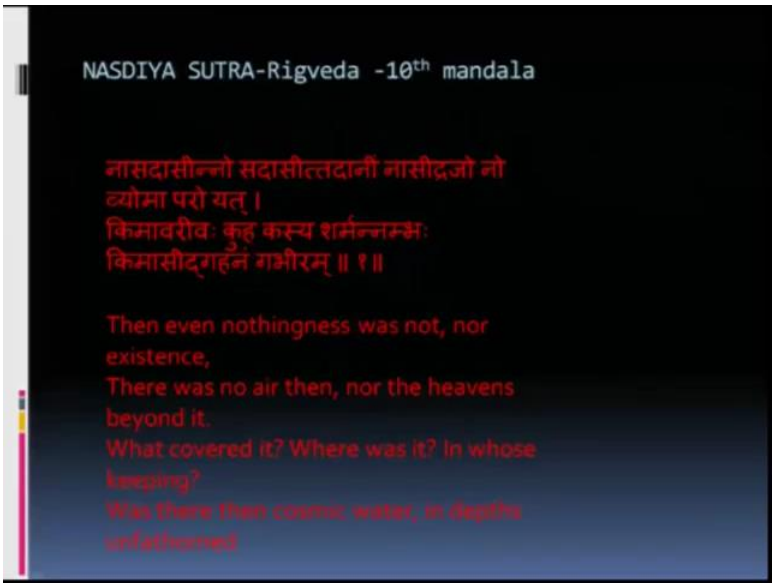

Then even nothingness was not, right before big bang may be if you want to fit in, what was there before big bang. Nothing, there was nothing was not there nor existence, there was no air then, nor the heavens beyond it. What covered it, where was it, and whose

keeping, was there cosmic water in depths on fathom. So, after writing all that the way of life and worship, and they questioned all this the origin, the origin of universe, this question is still actually have not been answered.

If you looked at it, specially you talked about multi worlds, you really do not know whether we have our big bang was no big bang, who knows, the fantastic theory is that if there is a black holes in our universe, there must be a black holes in other universes also, whether we emerge from some black hole from the other side, it may sound crazy, but believe me people when they sit alone, they ask these questions, because all is theory. you can go back and prove big bang, but because we have excellent explanations in quantum and other cosmology thing, but there is a possibility, but still lot to be explained.

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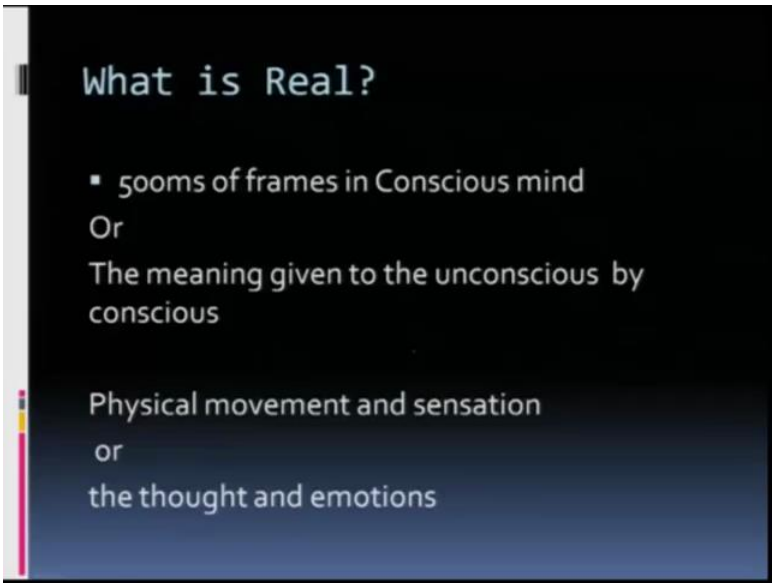

So, when it is lot to be explained the universe mind is still is. So, what is real, lets ask this question. I told you about that you do not become conscious before two undress milliseconds, and your unconscious mind is presenting whatever it has to the conscious mind. Is it 500 milliseconds of frames, everything you are becoming conscious of 500 and you think it is reality unconsciously. You do not know what is happening, you know only what is happening in your conscious mind, but when I am seeing this, I am looking at this recording whether I am seeing it in the way it is, or by mind which is creating it, whether it is a just 500 milliseconds of reality, anybody as there as own reality.

Possibly we think what is normal is, because everybody is thinking alike, because the same set of stimuli which is going on. suppose we change the whole presentation every second, then will the reality will remain the same, or it is whatever image comes to the mind, and the meaning given to it, what I see as red. you may not be seeing the red although you may agree, it is red, because that is the quality of brain, because it handle symbol a certain color has been given a name called red, and that red is what you believe, but where are we seeing the same red, you and me are we seeing the same, are we when the wind blows. Wind blows that is the physical quality, are we feeling that wind in the same way, we do not know.

So, we get the meaning, because wind blowing means 100 things to hundred people and that is why that is our uniqueness. So, your brain is handling the same symbol in a different way, whether it is a physical movement and sensation, or through an emotion what is the real touch, is real or meaning of the touch is real, meaning of the same touch may appear different to different people, when people are in love, the touch sounds very good, everybody want the touch would stay and imagine the same people, when they have married for ten 15 years.

When they angry of fighting hand, the physicality with the same, we cannot change, but the same physicality people get irritated. So, what is happening, is it your mind state. Mind state in sense that you are happy, you want to be with somebody, with some body and then you feel like it is good in another vocation. You are irritated, but the same chemistry in the brain. So, is it you have given meaning of, you have added some value addition to it, you have done a top down thinking, decided this is my lover, the touch is good and then your top down thinking that I am angry. So, you already told yourself that is what I told about that how does our mind, even before objectivity in mind is very difficult.

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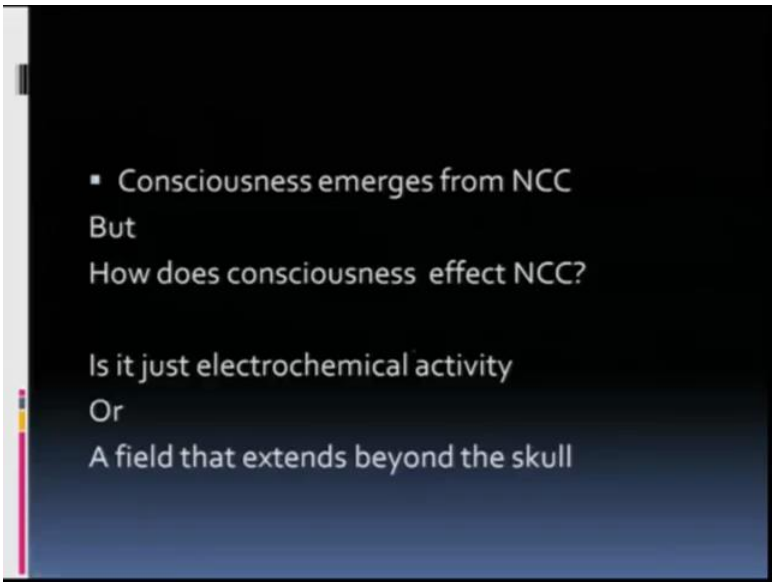

Consciousness emerges from what we call out the neural co relates of consciousness; that is brain elector chemical functioning network, but as I said how does consciousness effect, if consciousness is like a cloud or abstract envelope, how does it effect, because electro chemical activity is it what an also a big question. A big question is, is patterns of electrical firing, how they really quails into making an image, who seeing that image there used to be a homunculus theory, that the little man sitting inside the brain, who sees all this images. But then who is seeing that little man, how many little men will be sitting. So, we do not have a homunculus one screen. So, are there multiple screens in the brain, with images are been reflected and one of them finally, decided, we do not know right now.

And if they are created like this if image is created in a brain, how do you see, it agreed you see the external thing, how do you see the internal thing rare. So, it is field, electromagnetic field, or is it just electro chemical activity. So, let me add more confusion now. What is self. if you if you in the non-dominant, left is dominant in a right hand person in a parietal lobe damage in the non-dominant hemisphere, if there is a damage there is a concept of self is gone. There are people who have paralysis, but they will not recognize it as their own, they call something call (Refer Time: 26:13) where people do not recognize there that is what V S Ramachandran keeps working on a parietal lobe damage leads to the whole. So, possibly because I told about the stream of visual and we just telling you what and where that total orients, and the binding

oscillation probably binds all the information coming into the self's and give concept of eye, but the image of self is also disturbed in schizophrenia. If you remember that I told about the internal imaginary and the external imaginary. What are hallucinations? Hallucinations are perceptions without the stimulus being present in the external environment.

So, internal imaginary is being projected, and this person believes that. So, the boundary of self is broken. some schizophrenic patients feel that they mind is been controlled by somebody else, or some thoughts could it broken, or compare a illness like of obsessive compulsive disorder, whether the self is preserved, but the mind cannot stop repeated thoughts. So, they become intrusive, they almost like tennis balls which are thumping on boundary of self. So, it is just integration of information, but they will more do it, a person, but then if you talk of physicality you should read a book called (Refer Time: 27:48) and the butterfly. This person had a paralysis of all limbs, the only thing which is moving is eye leads and eye, and he is written a wonderful book dictated by just eye movements.

So, same brain he was locked in syndrome some is locked in syndrome, you are conscious, but he cannot respond. So, there is a total distortion of networks in the brain, like it happens in the dream your body paralyze. So, that you do not act on dream by paralyzing the (Refer Time: 28:24) system, by blocking the non-radial system external information does not come, so that you as cell Colin brings out the internal memories. So, that your information which you gathered in the day time, the information means the firing which is going on, is integrated with already existing synaptic strength, compared in that comparison lot of visual imaginary comes up, some of them is deleted you will never see, some of them is preserved. it appears very simple when I am telling you its huge process which is going on, and what timing it has to do it has to block the (Refer Time: 28:57) and it has to block the.

In fact, there something called run behavior disorder, where this distortion which happens them, and this happens temporally 20 minutes it will be there, and then back to integrate itself, where does the self-go in dream psychologically, where is the self, what self you are talking about your hands are not moving, you are not acting out on your dream

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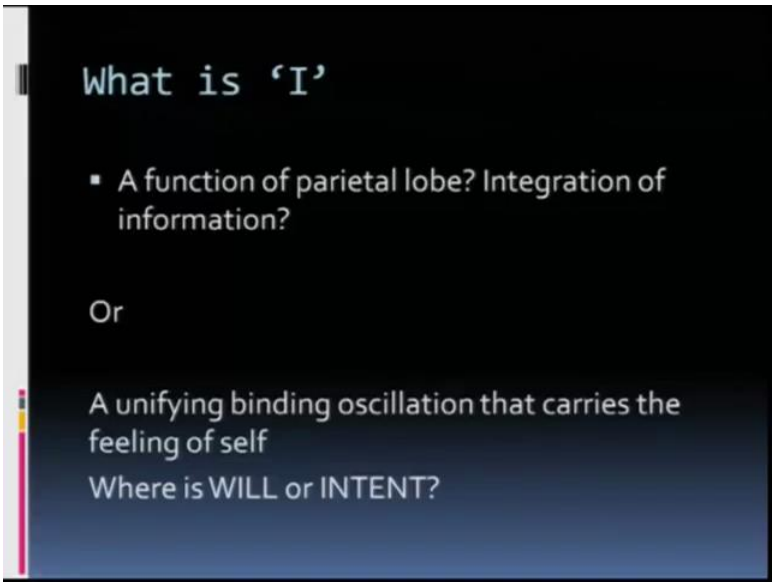

Anyway I will leave you these questions. So, I will continue this in the last lecture of this course.

Thank you, and see you in the next lecture.