Alfred Korzybski Memorial Lecture

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Dream Science and Human Consciousness

Delivered at the Yale Club, New York City, Friday Evening, November 8, 2002

Thank you so much, and thank you for inviting me. When I saw the list of previous speakers, I was really very humbled and awed. To think that my name would appear on that list, it brings tears to my eyes, as I think you can hear.

In 1951, when you gave your first Korzybski lecture, I had just graduated from high school. You might be interested to know that in 1949, Moruzzi and Magoun described the reticular activating system of the brain, a concept which was quite revolutionary. It's hard for us now to imagine what it was like without such a concept—that the brain self-activates. It doesn't just depend on light, and temperature, and other things that you might suspect were stimulating the brain—and they are; but the brain self-activates. And this was 1949, the year before Korzybski died.

In 1953, two years after he died, REM (rapid eye movement) sleep was discovered. So brain activation in sleep was discovered in 1953. Before that time, we didn't know that the brain self-activated in sleep, and of course it was natural to put Moruzzi and Magoun's idea together with Aserinsky and Kleitman's discovery of REM sleep, and begin to wonder what that really meant. And that is what I am going to be talking to you about tonight.

It's obvious what it means. The brain self-activates during sleep, and we dream when the brain self-activates during sleep. It's that simple.

But of course the self-activation in sleep is quite different from that in waking, and that's where the real money is—is in making a distinction between these two conscious states, these two states of consciousness, both of which are characterized by intense brain activation, waking and dreaming. And that's another important part of my talk. I'll try to explain to you how we do that, and how we use that distinction.

Now, before I begin to tell you sort of the nuts and bolts of dream science and how I think that applies to human consciousness, knowing that you are humanists as I am, let me read a brief poem to you. I wonder if you can identify it:

> *Dreams are but interludes which fancy makes. When monarch reason sleeps, this mimic wakes—compounds a medley of disjointed things—a band of cobblers and a court of kings.*

Does it ring any bells? It's a wonderful expression of what I'm going to tell you. And

I'm going to try to tell you what monarch reason is in terms of the brain, what the mimic is in terms of the brain, how the disjointed things get put together in terms of the brain. And well, that's quite a tall order isn't it? I mean that's a dream theory and a half.

And let me state at the outset, that this dream theory is meant to clear the decks for a psychological interpretive theory. It is not meant to sweep such a theory overboard. But psychologically oriented theories have tried to explain all of this, and they can't. They can't because this is what the brain does, and we don't know what the brain does when we are asleep. We are very poor judges of our own brain activity. No one ever intuited that the brain self-activated in sleep. It took Moruzzi and Magoun to show us that this was the case. And no one ever intuited that there was a stage of brain activation in sleep associated with dreaming. It took the discovery of Aserinsky and Kleitman to show us that this was the case. Now our job and our privilege is to strip away from the burden of psychological theory that which is generic—that which is related to the brain and only the brain. And then to look at what is left over with respect to the construction of a theory of dream meaning.

Do you follow me? OK.

Let me then begin by anticipating a little bit about what I am going to show you in these slides. I am going to take you through the talk before I turn the lights down because I'm aware of what might happen, despite my best intentions.

Consciousness is something that is about, I think, to be understood, perhaps, in terms of brain activation. But consciousness itself is not what I am talking about tonight. I'm talking about the states of consciousness. And I want you to get that point up front—that what I'm trying to explain is the way in which conscious states differ from one another, and the way that difference can be explained in terms of brain activity. So I'm not pretending to understand consciousness itself, although I think I do. That's not a scientifically defensible position yet.

What I'm going to be emphasizing in the talk—this is the second main point I want you to get—is that in order to do this we need to take a formal approach to mental content, not a narrative approach to mental content. What do I mean by that? Well, if I regard a dream report as a story, that's perfectly legitimate —that's a narrative approach. And I'll be inclined to interpret that story as a story. That's perfectly reasonable; but what about the grammar, what about the structure of the actual experience? That's what I mean by formal. To what degree does the subject see things that aren't there (read, for you psychiatrists, *hallucinate*). You hallucinate during your dreams don't you? I mean you see things perfectly clearly. Your eyes are closed, and yet, there the things are.

When I was, I suppose Korzybski-like preparing this talk, I had a dream which I will now recount to you.

I was here—of course it wasn't exactly here—but I knew I was giving this talk, and I had in my hands one box, about the size of one of those old Ampex tape recorder boxes, eight inches square and a half-inch deep. And inside the box was a rattlesnake. And there were several other boxes with rattlesnakes in them. And it was very convincing. It was very terrifying. It probably reflects my anxiety about this lecture, among other things.

But I want to use this example to show is that I could interpret the rattlesnakes in a lot of different ways, and so could you. You probably already have ticked-off five or six in your own mind. But rattlesnakes at least go with fear, don't they. They go with—I mean if you were going to think about something absolute-

ly fearsome, rattlesnakes would be on the list.

So that would be a formalist approach, as against looking at snakes in all the other ways that one could look at them. But surely they go with fear. And that's what I mean by a formal approach.

Now at the same time that this box was trembling in my hands as I perceived the muscular contractions of the rattlesnakes, my thoughts were, I would say, banal. I wondered why the hell did I bring these snakes to New York for this lecture? I couldn't figure it out. And since I knew the lecture was supposed to be about sleep research, I thought well, the snakes would make it difficult for people to fall asleep. Well, that's true, but it's a banal explanation for why I would bring snakes to the lecture.

The second thought was, well snakes would be a very potent stimulus for labeling the dreams, so I could use them in an experiment in which I was interested in tracking external data—extensional data into intensional dreaming. I'm trying to understand Korzybski as I speak to you.

But those are terribly weak reasons aren't they—they're not a reason for bringing rattlesnakes—very dangerous beasts—to New York. It just doesn't cut it as an explanation.

Furthermore, when you think about it at a second pass, the box couldn't possibly contain rattlesnakes; it's much too small, isn't it, much too small. And yet that never occurs to me at all during the dream. I don't say, "Well, those aren't rattlers, Hobson, you know. You've gotta be out of your tree: they couldn't possibly fit in a box that small." But dream logic puts them right in there, and accepts all of it as fact.

And what I want to tell you—this is point three—I mean point one is that the brain self-activates during sleep, point two is that you need a formalistic approach in order to understand the mental experience of dreaming, and to contrast it with waking, if you want to do anything with respect to the brain. And point three is that the formalist approach will show that dreaming differs from waking in the intensity of the perceptual experience, and the emotions which are stronger in general than we would have normally in waking, and the poverty of thought—the incapacity to rationalize what is going on.

Now you might say, "Well that's all to the good—we understand why that happens." You have your own theory about dream function. But before you do that, please follow me at least to this point, and see if you are satisfied or not with what I am saying.

Now, let me remind you of the poem, you know:

> *Dreams are but interludes which fancy makes. When monarch reason sleeps, this mimic wakes—compounds a medley of disjointed things—a band of cobblers and a court of kings.*

What has happened to monarch reason? And what is the mimic that has waked?

Point four is that monarch reason is my dorsolateral prefrontal cortex—don't be frightened by the words. You've got one, you're using it right now if you're listening to my lecture. You need to have that part of your cortex active in order to be attentive, to be critical, to direct your thought, to evaluate what I'm telling you—and to remember it.

And in dreaming, that monarch reason part is gone. It's just inactivated. So, this is a wonderful, for me, explanation. What more do you need to know?

Well, what about the mimic that wakes? The mimic that wakes is the lower brain, the part of the brain that is normally held in abeyance and in the service of monarch reason. But when monarch reason sleeps, this mimic wakes. This is the brain stem and all of the

lower structures which are responsible for the eye movements, which give REM its name, and for activating the brain during sleep in such a way that we see things that couldn't possibly be true, like the rattlesnakes, and feel them as real.

OK, so that's, I guess—I don't know if I'm at point four or point five, but I think I'm at point five. That's what I want you to get from this lecture. That the brain self-activates in sleep; when it does so it creates a state of consciousness which is different from waking. The way to detect that difference is to use formal analysis. When you use formal analysis, you will find that the thinking is impaired, hallucinatory perceptions are enhanced, emotion is enhanced, and that the reasons (point five) for these differences are the inactivation of the dorsolateral prefrontal cortex and the activation of the brain stem.

Now that's a tall order. That's a lot of stuff to remember, but you get me? You follow me, up to here, more or less?

OK, let's look at some pictures then, and I guess, let's see how much you want me to dim the lights.

You could argue against this definition of consciousness (but I'd like to emphasize a couple of points which I think are indisputable): *A graded, global integration of multiple cognitive functions yielding a unified representation of the world, our bodies, and ourselves.*

The important points for this lecture are *graded.* Your consciousness varies in intensity, doesn't it? Sometimes you are very aware, and sometimes you're not so aware, and sometimes you're totally unaware. So there's no question that consciousness is graded.

There's also no question that it's a global integration. And we'll say more about that in a minute.

Multiple cognitive functions—in fact what most psychologists do is study one of those multiple cognitive functions—like attention, or memory, or emotion, or perception. And as you'll see, we've chosen not to do that, but rather to take on something that Korzybski would certainly approve—a more global approach yielding a unified representation of the world, our bodies, . . .

Now it's *amazing* that consciousness is so undivided. It's true that you can have background reasoning now, or think about—have a fantasy about something else. But you really can't devote much of your attentional resource to that and get anything out of the lecture. And you're fully capable of playing close attention to what I'm saying. And you're very capable, in fact, you're obliged to pay very close attention to your dreams as well.

Now here are some of the components of consciousness, and I'm not going into all of them. But mainly to remind you that what most psychology has done is to carve consciousness apart at the joints and to look at one of these functions. This is what cognitive science today is all about. It's about attention, or perception, memory, orientation, thought.

And let's go on: the narrative structure, the emotion, instincts represented; the intentions (now intention with a 't', OK?), motivations, and volition. All of these are possible items for us to study. But what you notice when you look at cognitive science today, and you go through the journals, and there are huge numbers of them, is that it gets very technical in every one of these categories. And you end up wondering, "Well do they have it right, or don't they have it right?"

It turns out in this field that more is better. If you tackle the whole problem, it's better than looking at parts. And Korzybski would certainly like this, because the changes that are going to affect all of these functions must be global; and they must be powerful to affect all of these functions. And I say, in retrospect,

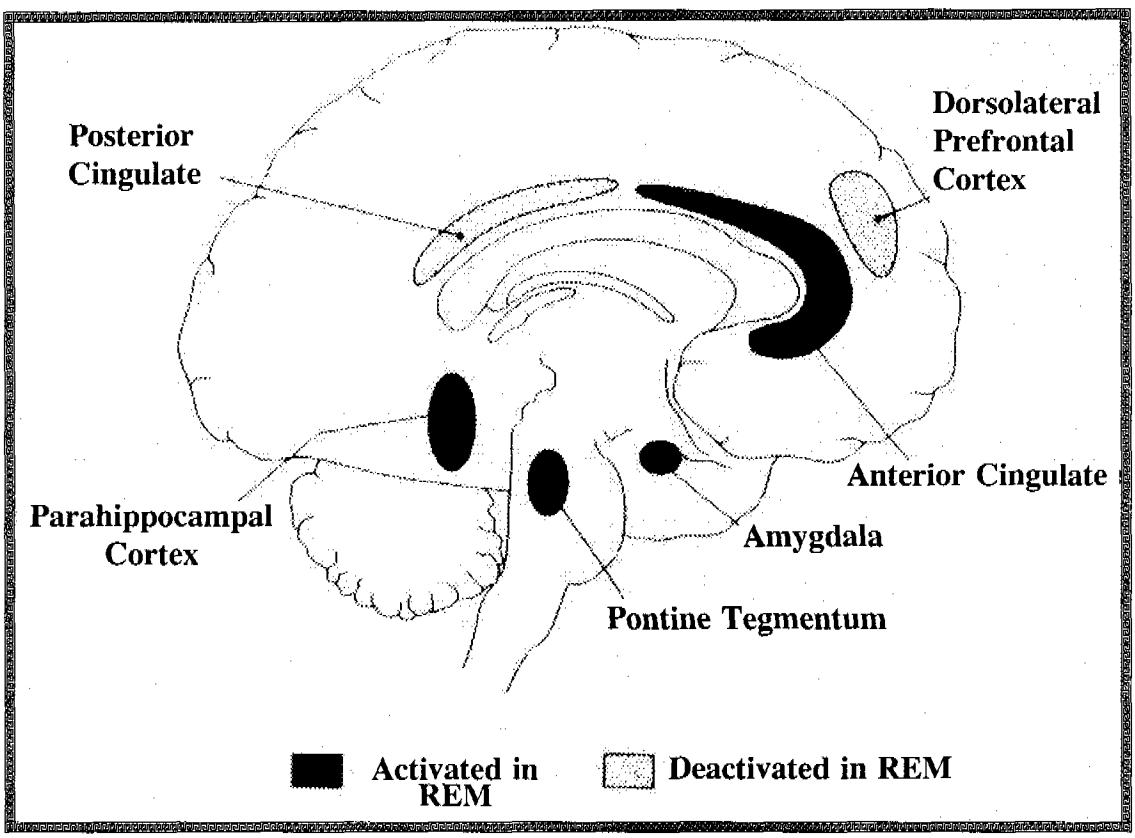


Figure 1.

The Human Brain.

they must be simple. That is, the brain must have a switch for turning from one mode to the other to change all of these functions at once. And indeed, it does.

OK, that's the conscious-state paradigm.

The kind or state of consciousness that we experience varies most dramatically as our brain changes state every day of our lives in the sleeping-waking cycle.

Now think about what this means. It's so obvious it's embarrassing to have to say that nobody noticed, apparently, that this was a very good way to get at consciousness, or at least how consciousness was regulated.

Isn't that undeniably so? I mean that your dreaming is not like your waking is it? Now we'll get back to this in a minute, but it isn't. It isn't. And you become completely oblivious when you fall asleep—so oblivious that in the early part of the 20th century, when Korzybski was alive, scientific greats like Pavlov and Sherrington both thought that the brain turned off in sleep. They thought it simply turned off—and that was why we became unconscious. But the brain doesn't turn off in sleep; it turns down to about 80% of waking levels. This means that the consciousness we experience during waking is riding on the very top crest of the wave of brain activation. You can still have 80% of your brain activation in sleep and be completely unconscious.

So the introspective notion that unconsciousness equals turning off the brain is wrong. It's true that it turns down, but it comes back on again, and we remain asleep. It comes back on again to levels at least as high as we have in waking, when we dream.

Now, how do we get it—these interesting ideas, scientifically? You have a strategy, which is to quantify cognition in subjective reports of mental activity and sleep. There is no way to study consciousness without studying consciousness. In other words, you have to bite the bullet and deal with subjective experience somehow.

Now, I have already told you that we prefer not to do that as narration. Lots of clinicians and psychotherapists are free to do so, but you can't make any scientific progress that way. You've got to quantify the cognitive aspects.

You can test measures of cognitive function post-awakening if you want to know what it's all for. I mean, is memory reactivated in a peculiar way in sleep, such that waking memory is improved? That's a reasonable hypothesis, and one that we are pursuing quite vigorously in our lab.

But now, what's the physiology going to be like? Well, we'll correlate the psychology with cellular- and molecular-level events. And now we're going to need an animal model because we can't do cellular and molecular-level studies in humans. But fortunately the sleep cycle of all mammals is essentially comparable. So that, although I would agree with Korzybski that animals don't pass down knowledge from one generation to the next, they share brain-activation in sleep to a very remarkable degree of fidelity. So looking at the physiology of the activation process in animal models is quite legitimate, and extremely informative.

What I'm going to tell you basically is that when your brain reactivates during sleep and you dream, certain chemical systems that are lodged in your brain stem are not reactivated. In particular, the norepinephrine and serotonin systems, which we know to be extremely important in modulating the brain during waking, such that we remember, can be logical, and all the rest of it—can distinguish internal perceptions from external perceptions—simply are not there. They have been subtracted from the brain. So that when the brain reactivates in sleep, these so-called aminergic systems are

turned completely off. No wonder you can't remember your dreams. No wonder you have so much trouble thinking in your dreams, because in fact during your dreams you do not have access to narrative memory. You may have a fragment of a recent experience, but you don't have the whole experience. You dream of people who are dead, and you don't know that they are dead, although in waking you immediately realize that that's the case.

So narrative memory is markedly impaired, and we think that's because of the loss of serotonin and norepinephrine.

At the same time the cholinergic system runs wild. This mimic wakes, monarch reason sleeps. Monarch reason in this case is in part the aminergic-neuromodulatory systems interacting with your brain, in particular, with your dorsolateral prefrontal cortex. It enables you to keep your mnemonic ducks in a row, more or less (as you get older you know, that gets more and more difficult); and to reason, to think about what things mean; to be analytic, to say to yourself, "Hey buster, that rattlesnake, you know, is a very funny rattlesnake, if it fits in an eight-by-eight-inch square, one-half-inch deep, box. There's something wrong here."

Now, it's very tempting to think, "Well, OK, that's a symbol"; all right, but we don't want to do that right in the first instance. We want to say, "Wait a second, why don't I notice that? Why can't I make that analytic judgment during the dream itself? Why do I have to wake up to do it?" And the answe, I think,is of this kind.

Now that doesn't mean that dreaming about rattlesnakes may not have some other meaning, but we shouldn't assume, in the first instance, that I dream about rattlesnakes in order to avoid thinking about something else, for example. It's a very popular kind of dream theory which I have inveighed against lo these 25 years.

Now, the most exciting new development in this field is the ability to image the human brain in action. With PET scans, and now increasingly with MRI (magnetic resonance imaging), we are able to study the human brain with regard to the regional blood flow, indicating the regional activation and inactivation of brain parts in humans while they sleep. And sleep is a perfectly good place to start with imaging techniques; and in fact, imaging techniques have been applied to this field now for almost ten years and the results are extraordinarily interesting. It is due to the imaging results that we know that the dorsolateral prefrontal cortex is inactive during REM sleep, when other parts of the brain are turned-back on again. And so on.

We know that the brain stem is activated in humans just the way it is in cats, rats, and other experimental animals. So there is an increasing consensus that the animal model is legitimate. Let's go on.

How do we actually do it? Well, as in all aspects of modern cognitive neuroscience, we needed a whole variety of approaches. We used a sleep laboratory, which you've read a lot about. People go into a lab; they have electrodes pasted onto their heads and eyes; they go to sleep, if they can. They're awakened during various phases of sleep, and their dream reports are collected.

We now have a Night Cap, which I'll tell you about in a minute in more detail, which enables us to distinguish the stages of sleep in people sleeping at home. This is a big advantage. It means to the subjects that they don't have to go to a lab, and have these—it's sort of a bizarre experience. You go to an unknown part of town, and you meet a technician whom you don't know, and he sticks all this stuff on your head, and then goes to the other side of a one-way window and tells you to sleep. Naturally, well, good luck. It just doesn't happen.

We have brain imaging, and we can study the animal model with micro-electrodes. We can identify single cells, and this is the way that McCarley and I discovered that the noradrenergic [norepinephrine-containing] neurons of the brain stem were turned off in REM sleep, when most scientists believed that they would be turned on.

Having discovered that, we can then use micro-injection of chemicals and induce experimental REM sleep by exposing tiny portions of the animal's brain to cholinergic-agonist drugs. We produce REM sleep in minutes; it lasts for hours. It's extremely convincing. And those animals can be waked up. We don't say they're dreaming, but why not? Those of you who have pets assume that your animal friends feel, they recognize you, they perceive, certainly. Why couldn't they have some animal kind of dreaming even though they can't give us reports; but there can't be a literature about dreaming that conveys one generation's ideas to another.

And we have brain-imaging capability in the animal model as well. And that has not been done yet, but it should be done because we need to know the degree to which the regional redistribution of activation is a function of the changes in the neuro-modulators.

Now let me explain just briefly what that means. (We're going to come up for air pretty soon, so don't worry. We'll show you some nice pictures of dream reports.)

The question is this: The regional activation of the brain is a function of what? Why does the blood flow change when we go from waking through slow-wave sleep to REM sleep?

Well, what do these noradrenergic and serotonergic neurons do as a rule? They're part of the autonomic nervous system. And if they don't influence blood flow, I will eat my Korzybski honorarium in your presence.

It seems to me very likely, that is exactly what happens—when the brain stem changes the output of these chemicals, then the regional blood-flow changes are a part of that process. It makes all sorts of sense, it's reductionistic, and it gives you a simple explanation for everything, which is what we want.

Now, I've already told you what I think a dream is, and this is a formalist definition. And it is the formalist definition of a psychiatrist. And the reason is that I think dreaming is a superb example of a normal psychosis. We all do it: we see things that aren't there; we believe things that couldn't possibly be true; we have all sorts of cognitive disabilities; we have strong emotion; and we can't remember any of it. I mean it's absolutely great.

What kind of psychosis is this? It's not schizophrenia; there's no paranoia. The hallucinations are visual, not auditory. We do sometimes hear things, but we don't hear people talking about us. We hear conversations, but sometimes dreams are amazingly silent; but they are never non-visual. So visual hallucinosis is the leading perceptual formal quality—and we accept these things as real, I mean, these rattlesnakes that were in this box were real for me. There was no way that I could reason that stuff away.

Now, you say, well that's just because the perceptions were too strong. No, I think not. I think that my thinking capacity is also impaired. It's true that the perceptions were strong.

And then I have all these spacio-temporal disregulation symptoms, such as scene shifts, time compression. We say now that this is dream bizarreness. When a person tells us they had the strangest dream, what do they mean? They mean that time, place, and person is inconstant. All of the Aristotelian unities are violated in dreaming. Times, places, and persons change without notice. This is important.

This sounds like disorientation, doesn't it? Well if you have visual hallucinations, and disorientation, now all you have besides the amnesia and the strong emotion, is confabulation—and you've got the organic brain syndrome. This is what is meant by the title of my book, *Dreaming As Delirium*. Dreaming *as* delirium, dreaming *is* delirium, by definition.

So, what kinds of processes cause delirium? Well, drugs are a very common ... what kind of drugs? Drugs that interact with the aminergic and cholinergic modulators: amphetamine psychosis—alcohol, cocaine, all of these drugs which cause delirium interact with the chemicals in your brain and my brain. These chemicals are normally involved in determining this peculiar alternation of states.

OK, formal features of dreams: enough of that—I think we don't want to beat a dead horse too hard, but there are lots of formal features to investigate. We've looked at the sensory domain of hallucination. We've found that vision is omni-present, that audition is present in about 80% of the cases, and on down the line. What is conspicuously absent from dreaming is olfaction [smell], taste, and pain. Now you say, well, I've had pain in my dreams, but think about it. Think about the scenarios in which your body was actually being attacked or mutilated, and there's not much pain. So pain is underrepresented—we'd like to know why; we don't. We understand, I think, now why they're so visual. And so on down the line. Bizarreness I've reduced already to orientational instability. Delusion of function, weakening the cognitive processes in general. Impaired self-reflection—my God, It's amazing. I mean every time I have one of these dreams, and I'm a world expert, I'm fooled. I never ever suspect that I'm dreaming. I think I am awake. Now, I can cultivate lucidity. And you are going to hear about that tomorrow, or some of you are; but it's very evanescent, and even when I'm very lucid, I lose it very quickly. So the tendency is to believe what I see uncritically. And to regard this whole internal intensional process as if it were real—extensional—as if it were extensional—as if it were the outside world. But it isn't. The minute I wake up, I know that these rattlesnakes aren't real; they couldn't possibly fit in the box; why am I even contemplating taking them to New York?

The lack of orientational stability: I don't know that I'm in my bed in Brookline, I think I'm here. Even though I've never been here. It just feels like I'm here, and the emotion is very convincing. And so on, and so forth. I think you are following me.

Now, this is the last of the sort of formalistic, scientific slides, very important. I'm going to show you a three-dimensional state-space model, based upon these three dimensions. So try to get a grasp of what I'm saying.

The level of consciousness, generally speaking, whether you are awake, asleep, dreaming, whatever, varies as a function of activation (Moruzzi and Magoun, 1949, reticular activating system); with a high level of activation, you're going to be very aware. You might be aware of the outside world, or you might be dreaming and be completely intensional. The focus changes as a function of input-output gating. The activation is selective in the following sense: That during dreaming, when the brain is turned on to every bit as high an extent as it is in waking, the input-output gates are shut. They're actively closed. So, you cannot in fact hear or see things very well when you're dreaming. You're unaware of external stimuli because those are blacked out, and we know the physiology of that very, very well. We also know that you can't move. And one of the key formal features of dreaming is movement, isn't it? You never dream about sitting still, do you? I never do. I never dream of

sitting at my desk, I never dream of talking on the telephone. I never dream of doing science, writing papers. That's what I do most of the time when I'm awake. What I do during dreams is run around, and I go to New York, I go to a lecture. I take a bunch of rattlesnakes with me. I run up and down the stairs of this horrible hotel, and I can't find the f---king room. And you know, where is my passport, and on and on and on. But I don't move at all. I feel like I'm moving. I have the hallucination, the very convincing hallucination of movement.

Now, my wife knows a lot about this. When this system of turning off (the immobility) fails—then people do act out their dreams. But most of us don't. We don't remember them. We feel like we're running around, as shown in dreamers' art, and you'll see some illustrations of that in just a minute.

Most important, the form of consciousness changes as a function of the modulatory system. Now by modulatory system I mean these chemicals. I mean norepinephrine, serotonin, acetylcholine, just for starters. There are going to be 20 or 30 more, so hold on to your seats. The neuroscientists are going to get in this with both feet.

So now we have three dimensions, but most sleep charts are shown in two dimensions. Something is moving along in time. In my model, time is the fourth dimension.

The three-dimensional state-space model says that the state of the brain-mind, hence the state of consciousness at any instant in time, is a function of three factors: One is activation. Activation runs along the front wall of the state-space. So as activation falls, we go to sleep. If we were to go into coma, we'd move way down into the left-hand corner of the state-space, right? Activation will determine *the degree* to which we are conscious.

The content of consciousness, whether it is extensional or intensional, is a function of the axis running back from the front of the state-space to the rear. And in the back of the state-space, the gates are open, you're awake; I hope you are awake; are you awake? Are you listening, are you with me? Are you paying attention? Yes, yes, yes; but if not—if you go through the REM state, through the non-REM state which is in the middle of the state-space, and enter into the REM domain, then this changes altogether. External stimuli are blocked, and internal intentions to move are blocked.

So that helps us explain some of it, but there's more to it than that, isn't there? I mean, REM sleep is almost qualitatively different—dreaming almost qualitatively different from waking. And in order to explain that, we need the modulatory dimension, which is the Z-axis, running vertically, which says that at high levels of modulation, aminergic systems are on—you can perfuse your brain with norepinephrine, serotonin. When you dream, those systems are turned off. Although your brain is activated, it cannot process data in the same way, for those reasons. OK?

Now, that's the end of the technical part of the talk, and I can see that you're a bit foggy. Let me get you back up for air now, and show you something a little bit lighter, that I hope will make these points.

What I've tried to do up to this point in the lecture is to get you through those first five points that I made. You know, that activation is a very important determinant of the level of consciousness; that input-output channels are open or closed, and they will determine whether we process internal data or external data. The way that we process the data is a function of the chemical micro-climate of the brain. And it goes a long way to explaining a lot of the formal features of dreaming. The psychological theories do not have to explain these things anymore. Freud was stuck with a

whole ball of wax. He had to explain all of these things in terms of a psycho-dynamic theory. It falls by its own weight. It's obviously almost completely wrong. And now what we need to do is to construct a theory that is very different—[one that] will, I think, be very different from Freud's—but it shouldn't offend the Freudians because we're going to say that emotional salience is the essence of dreaming. And that dreaming is transparent—not disguised and censored. That what we do during dreaming is to match things in your cognition with your emotions. What could be more straightforward and delightful? You don't need a complex decoding system to understand most of this. And to do what those of you who are therapists, and I am one of you, would like to do. You talk about the dreams, and meaning as such is transparently clear. It's embarrassingly clear, in my case, I mean my dreams are naked, they're horribly undisguised, and it's interesting that for so long we've kept this idea in mind that dreams are wish fulfillment—I mean these rattlesnakes, I didn't wish at all—created a lot of difficulty dealing with the negative effects in dreams. And I think that dream meaning is right on the surface, and is there for anyone to enjoy and exploit.

I'm not going to talk about the brain diagram. Let's look at some pictures.

Now, when we were beginning to study the formal aspects of dreams, we naturally asked our colleagues to send us dream reports from sleep labs. But as I've already told you, sleeping in a sleep lab is a very strange experience. And usually you don't have more than four days to get used to it. That's nowhere near enough.

When I slept in the sleep lab, I was awake the first two nights because I could hear the pens and I could hear the technician, and I could hear all the rest of it. Then I was so sleepy, so sleep deprived, that I couldn't be woken on nights three and four. You know, this is a silly way to do things.

So, before we had the Night Cap, and I'll tell you about that shortly, we started looking around for dream journals. And this is an illustration from a dream journal that I got as an honorarium, as it turns out, for an after-dinner speech of this kind about 20 years ago, to the Boston Bio-Physical Society. They said, you're a Harvard colleague, we can't pay you cash money, we'll buy you any book you want. And I had seen this dream journal advertised in John Gach's lists—if you don't know John Gach, you should—he's the best medical-psychological antiquarian book dealer in the country, if not in the world. And this is a drawing that accompanied a copper-plate handwriting report of this dreamer's walk through downtown Washington with his nephew James. And it's filled with classic dream bizarreness. And that is epitomized by this beautiful drawing of the customs house that they beheld during their walk.

Now notice that this is an architecturally possible building, but highly improbable. It's a bit like the Beaubourg Modern Art Museum in Paris. You can go up the outside to get to the second and third floors, but there are no doors. And you can only reach the second and third floors by means of these ramps. And you enter via the windows. Well you could get involved in a whole lot of interesting speculation about why this guy dreamed this thing up. But the fact is that he did, and it's classic dream incongruity. And we say that is probably a function of his somewhat addled brain.

The next slide shows another example. It's quite possible to stand at home plate down here at the bottom, hit a single into center field, and run to third base via the pitchers mound. But most people don't do that. They run to first base instead. He has this peculiar trajectory which he's very kindly drawn for us. And

peculiar trajectories are very common in dreams. No one has ever noticed that because no one ever bothered to look at the formal aspects of dreams. What could this be due to? Well, the mimic that wakes in the brain stem includes the vestibular apparatus. The vestibular apparatus is the part of our brain that tells us where we are located in space. And the vestibular apparatus is getting no input from the outside world. It's not receiving the usual information from the semi-circular canals because that input is blocked. But it's receiving all sorts of false parasitic information from other parts of the brain. And that's as good an explanation as we can offer right now for why this particular dream scenario occurs. Next slide.

Now, dream scenarios are not just crazy. They do have a certain creative logic attached to them as this desktop computer drawn in 1937 illustrates clearly. The dreamer was an insect specialist at the Smithsonian. And he had all of his data on 5-by-7 cards. You can imagine. They were in the drawers of this Grand Rapids Oak desk. Now, how does he access the data on the cards? Well, in his dream he imagines that there are these alphabetical flags on the top of his desk, and when he wants to get all the cards of insects whose names begin with D, he just presses the D flag, and the appropriate drawer comes out, and there are all his cards. So, it's really remarkable that this is as goofy as the "band of cobblers in the court of kings", but there's something to it. He wants to have a better way of accessing data, so he invents, 30 years before the fact, a desktop computer. And it's not only intellectual pursuits that are so meaningfully represented. Next slide.

This is a bicycle built for two. Notice it is connected by a catenary. No such bicycle has ever been seen by anyone in this room, I suppose. Especially with no one on the second bicycle. But our dreamer is a bachelor, and he recognizes that this dream represents his yearning for a soulmate, for someone to share his life with him. So the emotional meaning in this case is not disguised at all. He gets it right away. He writes the dream down, and he tells us that's what it means. Now, I'm not saying that I'm sure he's right, but I'm telling you that it's transparent. And you don't need to be a psychoanalyst to figure *this* stuff out.

So, how do we work today? I'll give you two little snippets and then close. I hope there's some discussion, and hope I haven't put you all to sleep.

Here is my co-worker Bob Stickolds' eighth-grade daughter, who did this project for a science fair. She uses our Night Cap to record her own sleep. What the Night Cap does is to record just two channels of information. One is for head movement. There's a bulge, as you can see, in that bandanna just over her left eye. And there's an accelerometer under there, so every time she makes a posture shift, it puts a count in the box. More important, she has a piece of sticky tape over her left eyelid, which may be hard for you to perceive, but it is very sensitive to eye movement because the lid is distorted every time the eye moves. And using these two channels of information, we get extraordinary data. Next slide, please.

You don't have to be a sleep physiologist to see the periodic brain activation reflected in the eye-movement channel of the two-channel event recorder which is above. Notice that when she is going to sleep at the beginning of the night, here on the left, there's lots of activity, and there's lots of head movement. This is tossing and turning, trying to find the right position to go to sleep.

The minute she falls asleep, the activity ceases in both channels. So lots of 1's in both channels tell the algorithm that the subject is awake, and lots of 0's in both channels tell the algorithm that the subject is in non-REM sleep.

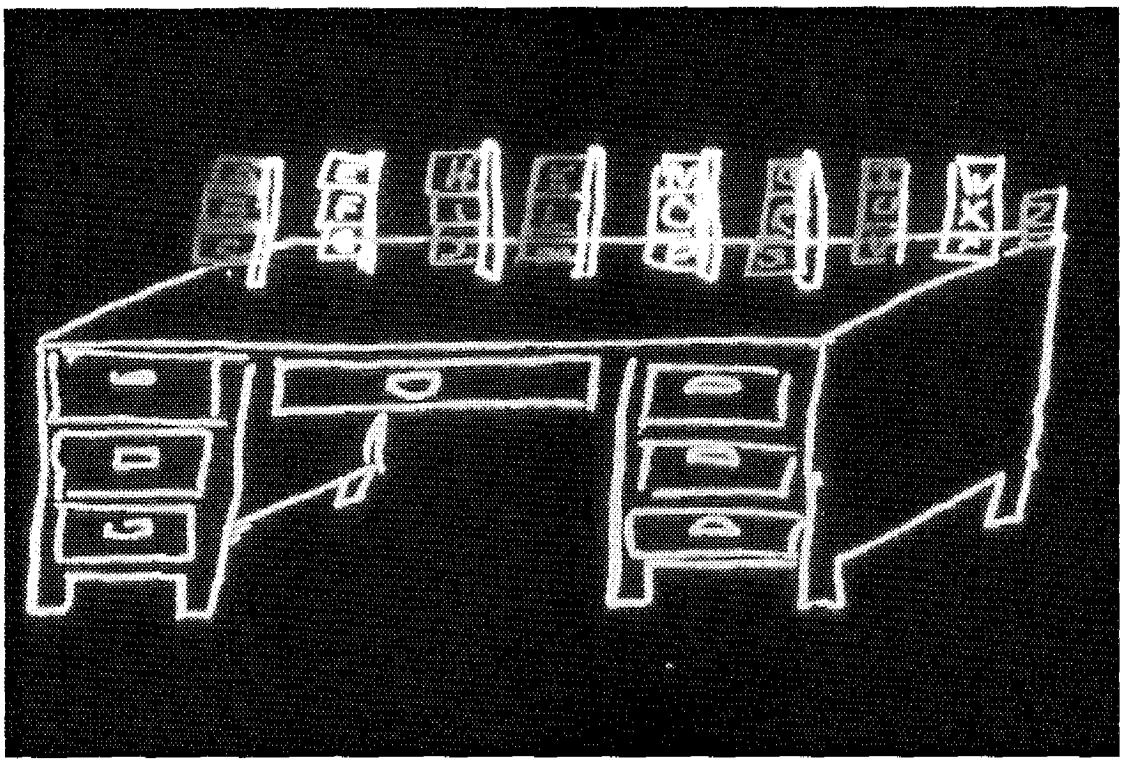


Figure 2: 1937 Dream Computer.

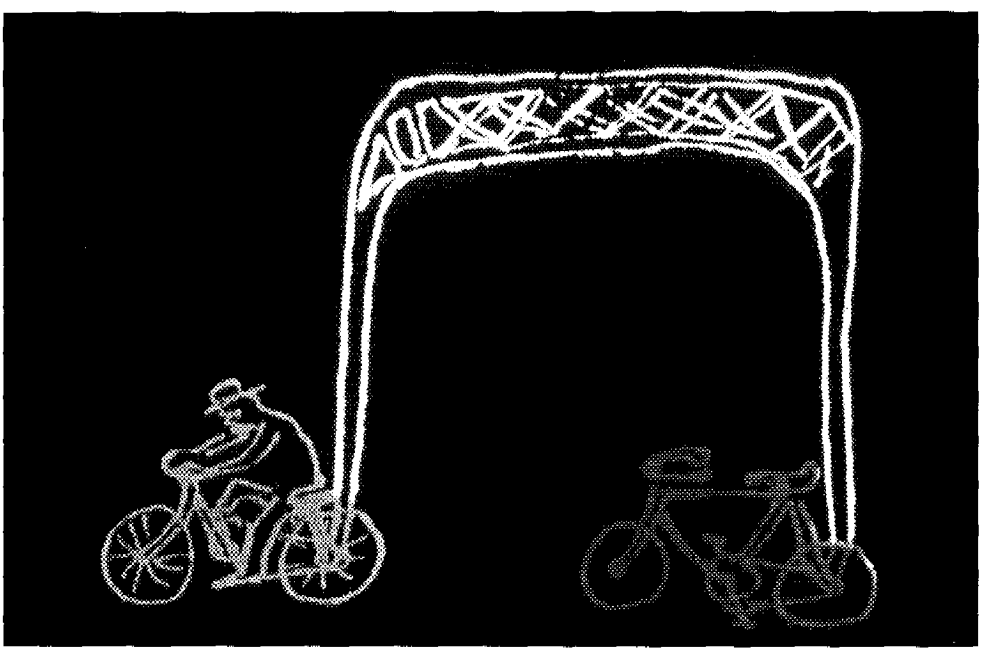


Figure 3: Bicycle Built for Two.

So the algorithm is really good at distinguishing these two states.

What about arousal here which occurs halfway through the first cycle? You see eye movements and head movements in both, the subject wakes up briefly, goes back to sleep, then has the first of two relatively weak REM periods. And the first two REM periods of the night are typically weak, but they are characterized by clear clusters of eye movement, and by relatively little head movement.

Look what happens in the second half of the night. These eye-movement periods go on for 45 to 50 minutes, and you can see not only the enormous number of eye movements, but notice that there are at least five peaks in that mountain range. How many dreams are in there? Well, we don't know. It's something we'd like to look at with this technique.

If we let this subject sleep through the night, never wake her up, or she doesn't have a spontaneous awakening, as the subject did in the beginning of REM period three, we never know anything. But if we do spontaneous awakenings, or if we beep the subjects with a computerized program, we can record the sleep in real time. We can perform awakening studies. We can ask the subject what was going on in his or her mind when awakened. We can ask the subject to perform cognitive tests. We can do a lot. All of this can be handled on a bedside computer now. So the whole lab is in the subject's bedroom. All we need is a phone-line connection.

And we've done this study which we've called the grand-mentation study. We have three-thousand reports from the same subjects, in wake, sleep-onset, non-REM sleep, and REM. And you're going to see this whole story in the next slide, and I hope it will sum-up what I've said to you. Next slide, please.

If we score the reports—now remember these subjects are being waked up at night, they're also wearing a beeper during the daytime, they might be beeped at three o'clock in the afternoon—they're asked what's going on in their mind.

So we have controls in waking, we have five sleep-onset sampling periods, we have non-REM sleep, we have REM sleep, we have three thousand reports.

We go to those reports and we say, "How often does the subject mention thinking? Does a report contain *any* reference to thinking or not?" And not surprisingly, active wake is a little bit less thought-like than quiet wake. You're more likely to be reflective if you're not moving. But that tendency to report thinking declines dramatically at sleep onset. It goes to about 40% of its wake level in non-REM sleep, and has its lowest level in REM.

Now remember, the brain is generally activated during REM, but thinking is practically impossible.

Conversely, the degree to which the subject reports having internal perceptions is exponentially increased while thoughts are decreased. Active wake is the lowest; quiet wake is a little bit higher. At sleep onset, there's quite a little bit of visual activity. In non-REM sleep, there's a very respectable amount. But again, the maximal state associated with a hallucinoid mental activity is REM.

The ratio of hallucinosis to thought is exponentially different between waking and REM sleep. So these two states of consciousness, both characterized by high levels of brain activation, are almost qualitatively different in terms of their formal properties. No wonder the content is so different. Next slide, please.

So this is the low-tech side of the story. Let's switch for a minute to the high-tech. Above are Pierre Maquet's PET scans of the human brain during REM sleep, where the subtraction is made from REM sleep to waking. And colored spots like the yellow, which

are of the brain stem (of the upper left sagittal schematic cross section), are evidence of brain stem activation.

Over here, we see the thalamus, and up there on the upper right, we see the amygdala activated; and certain areas of the visual cortex are activated. I've tried to summarize that in what is unfortunately a ghost-like image below, showing the areas of activation in REM sleep compared to waking. They are the amygdala, the emotional centers, the brain stem, the para-hippocampal cortex. All parts of the cortex that are integrating emotional experience. The anterior limbic system is shown by the spots in purple. Whereas the dorsolateral prefrontal cortex, the monarch-reason part of the brain, is turned off with respect to waking. It is not reactivated, in other words. The polysensory cortices are also activated during this state. Next slide, please.

In fact, this work has been done mainly in Europe and the United States by four or five labs, and is complemented by the work of Mark Solms, who has gone to stroke patients and asked them whether their stroke produced any changes in their dreaming.

Now, why didn't Sigmund Freud, who was a neurologist, think of doing this? This study could have been done a hundred years ago.

But it was assumed by everyone that the brain turned off in sleep. It was so silly. What Solms found was that exactly those areas that light up in the PET scans, when damaged by stroke, cause loss of dreaming. So there's a double dissociation of complementarity between the lesion and the recording studies. And that's very exciting to us because complementarity of data that fit together make all sorts of sense. The brain stem is activated, the dorsolateral cortex is deactivated, and the parietal operculum, which is the part of the cortex that is responsible for integrating spatial information, is activated.

When those same areas are lesioned, dreaming either stops or is markedly altered. So there is a neurology of dreaming now, as well as a neuro-physiology. I think the next slide is the last one, and you'll probably be happy for that.

I conclude that consciousness is the forebrain's representation of the world, our bodies, and ourselves. It is always a construction; that is, we are in fact confabulating, making up stories about ourselves all the time. But this is the punch line whose level, focus, and form depend upon the brain stem.

Now let me see if I can remember another poem to match the one that I told you about. Let's see, how does that one go ...

Those dreams that on the silent night intrude, and with false flitting shapes, our minds delude, Jove never sends us downward from the skies, but all such sensations from the brain arise.

And when he also has a final couplet, he uses the terms, *all are mere productions of the brain, and fools consult interpreters in vain.*

Now that's not the same poet as the first one. So I'll be happy to have your questions. If anyone can identify the poets, please let me know. Thank you very much for inviting me. I hope that this has been reasonably lucid and exciting for you.

As you begin your second half-century, we are in a truly new age. Let me say in conclusion, brain science is a genuine renaissance. It will change the nature of the humanities without any doubt, and Korzybski, I think, would be very pleased about that.

Thank you very much.

[Thus ended the formal part of the lecture, but then questions were invited from the audience.]

Bob Pula: I present this directly to you Dr.

Hobson, as brain, because I consider that we are here to communicate as brain to brain. I recently witnessed a performance of *The Tempest* by Shakespeare, in which that marvelous genius says, "We are such stuff as dreams are made on; and our little life is rounded with a sleep." And this suggests to me the identity theory of brain—our mind, so called, and brain structure. And I have read much of your stuff, and it seems to me that you are inclined to be an identifiest. And I would just like to know your reaction to that.

Dr. Hobson: Yes, I'm trying to be a mind-body monist. Of course, that's impossible; but I go as far as I can with it. What I've tried to do is to show you that we can go quite a ways if we are modest. I may not sound modest, but a formalist analysis still leaves open the question, "Well why the rattlesnakes and all the rest of it?" The content analysis, however, is relieved of a huge burden by virtue of the mind-brain identity story. The mind-brain identity story, by the way, is not to say that there is no such thing as mind. It doesn't reduce mind to brain, because mental experience is subjective. And that's the amazing thing about consciousness—there's an agency, a self, who has the experience. That's a construction. And I think that is a brain function. There's nothing wrong with looking at things that way. What I'm trying to do is to show the degree to which our subjectivist approach to our own conscious experience is misleading and erroneous. And I think it is very misleading and very erroneous, and I think the dream theory shows it. I hope I've made myself clear on that point.

Let's have some more questions. Yes, sir?

Question: Where does the imagination fit in your schema?

Dr. Hobson: Well, I don't know where . . . "Tell me, where is fancy bred, in the heart or in the head?" Ah, well, I'd say the head for sure. But as Morris Bender used to say to medical students at New York University when I was interning, "Where in the head?" I have no idea. But it strikes me as reasonable to assume that there is a conjunction between the PET studies and Penfield's studies (stimulating the brain in open surgery for epilepsy). In other words, confabulations do arise when the temporal lobe is activated. And the temporal lobe is selectively activated in all of us during sleep. And we are extremely imaginative; I would say, formally artistic, as well as formally delirious. So, I'm not using the delirium analogy to say that this is all negative mental activity. I think that imagination is there, too. Look at those drawings. They're extraordinary. That's one reason why he made the drawings. His life was rather drab. He was a bachelor. He lived in Rome. He classified insects, you know, before DNA, before they had any sort of dynamic biology to work with, he was a taxonomist. But he loved his dreams because in his dreams he could do all these things. Lots of them had to do with sports, all sorts of things.

Yes, imagination is there. This mimic wakes, and I've given a gloss on what the mimic is. We need to know a lot more about that, and we will ... So whether that will satisfy you as an explanation of imagination; but what is imagination, after all? It is a band of cobblers in a court. It's putting things together that don't appear to belong together. The Korzybski lecture and rattlesnakes, what do they have in common? They both have anticipatory anxiety as an emotional salient underpinning. I think emotion is in the saddle, and I think that is what artists are telling us, that they want to get away from literal, linear logic; they want to be associative, and they want to represent in their art associative responses to the world, which are credible enough to be recognizable as such. So, you know, I've just written a book with Helmut Wohl which, if any of

Findings

Level of consciousness changes as a function of activation.

Focus of consciousness changes as a function of input-output gating.

Form of consciousness changes as a function of modulatory neurotransmitter ratios.

Conclusion

Consciousness is the forebrain's representation of the world, our bodies, and our selves. It is always a construction whose level, focus, and form depends upon the brain stem.

you know a kind-hearted publisher, please let me know—the visual program is so expensive that no publishers want it. It's called, *Angels to Neurons: Art and the New Science of Dreaming*. And we talk a lot about creativity in that book. And we talk along the lines of my answer to your very kind question. Thank you.

Question (different person): I don't remember the book in detail. I read Sir Francis Crick's *Astonishing Hypothesis*, and I was curious about your thinking, if you've read the book, and what you thought about it. And I also wanted to say it strikes me that—why is the eye the thing that we observe as scientists in REM? And is there a connection between—because he says in that book that the eye is the one thing that we can't really nail down or explain as far as consciousness goes.

Dr. Hobson: Don't ask anymore, please, it's a great—there are two questions, and I'll try to answer them in an integrated way.

Crick's *Astonishing Hypothesis* book is focused mainly on vision. And he did that for a good reason. We know more about the neurobiology of vision than we know about anything else. But he didn't take up the vision that can occur to us when our eyes are closed. And that's a big surprise because Crick, before he wrote that book, dabbled a bit in sleep and dream science, as you may know. He said that we dream in order to forget. He was following David Hartley, who in 1804 said we dream in order to forget: we dream in order to loosen associations, not tighten them. For otherwise, we would become mad, he says, in the obsessional manner. So I love Francis Crick. He's a genius. He's a great friend. He learned what he knows about sleep research from me, so I'm to blame for his leaving it out.

Now let me summarize by saying I don't think the hypothesis is astonishing at all. I don't see how or why anyone would want to defend an alternative hypothesis. All the alternative hypotheses are dualistic. Dualistic hypotheses are simply not going to wash. There is no mind without the brain. I'm sorry, folks, for those of you who are counting on immortality. I don't hold out much hope to you, because I think when your brain dies, your mind will die. You will live on in the brain-minds of other people, yes, sure, and maybe that's what Korzybski was talking about. But I think that's a provocative title; I don't think it's any longer astonishing. And when I say I think the mind-body problem is solved, I mean to emphasize vision research. We know that we don't actually behold the universe, we decompose it and recompose it. The retina and the geniculate body in the visual cortex are responding to little edges and lines and colors—all sorts of pointilistic aspects of the external world—and then recomposing the whole inside. It's a pretty damn good match, we assume. Of course, we have no way of being sure about that, but it's a pretty good match. So I say that because visual representation is already known to be abstract, known to be constructive, that the mind-brain problem is solved.

Question: Has there been any brain-imaging research comparing or tracking the change in a given dreamer from being a naive dreamer who doesn't pay attention to their dreams to becoming somebody who studies them, or similarly any brain imaging that's been associated with laboratory or other studies of telepathy-type dreams.

Dr. Hobson: No, the answer to both questions is no, and the first question is to my mind a more inviting one, which will have scientific payoff. I suspect that telepathy, with all due respect to Montague Ullman, is a long shot. But, that people's dreams will differ, and that their brain imaging will differ accordingly, strikes me as very likely. And the answer is that it hasn't been done yet. Why hasn't it been

done? It's too early. These are very expensive studies to do. And the MRI has not yet really reached technical satisfactoriness. It will happen in the next five to ten years, for sure, and then you will begin to get answers to the first question. You could do the second study, but I don't think you'll get a funding agency to pay for it in the near future because the empirical evidence in favor of that idea is rather weak.

It's a little bit like lucid dreaming. Lucid dreaming would be a very good thing to study, wouldn't it? But it's unlikely to be chosen because Laberge has made such a mess of the science that you can't get the committees to give you the money to do the work. Anyway, let's let that one go for the time being.

Question: If someone has a stroke, is paralyzed on the right side of his body, assuming that the stroke is on the left side of the brain—because the stroke occurred on the left side of the brain, he can't speak, what effect does this have on his dreaming?

Dr. Hobson: Well, he can't give you a dream report, you see, that's a problem. But nobody's done the work. No, no, I'm not answering the question in a derisive way. I'm not, it's not meant to be funny. It's a problem. How do you get the reports from a guy who is aphasic? That's a tough one. My guess would be that he doesn't have language in his dreams either, but you know ... Can he name things that he sees? I don't know. Can he construct a narrative as well? Probably not. So his dreams might become more like those of an un-linguistic animal. But we'll never know. It's moot.

Milton Dawes: In trying to understand some relationship between dreams and consciousness myself, there is this commonality that I see or suspect. We're not always self-conscious, not every single moment.

Dr. Hobson: Not every single moment, but if you want to be you can be.

Dawes: That's very hard.

Dr. Hobson: It is?

Dawes: I may be walking along the street for instance, and we are not self-conscious constantly every step, every single step, every single instance. [Hobson: "That's true, that's absolutely true."] And the next moment, we realize that we are going on the street someplace. ["That's right."] So in that sense it's near to dreaming in that you're here and in the next moment you're there, somewhere else.

Dr. Hobson: Yes, the way to get at that is using our oral approach, to meet people. We get very few reports of individuals saying that they were having fantasies and were not, therefore, in the world. I know that happens. It happens to me all the time. But it doesn't happen that often. It doesn't happen often enough for us to easily sample it. And so what if it did? It would only mean that there are no absolute distinctions between any states. And that fits with—you know, my approach is statistical, numerical—I'm saying that the probability of having a high degree of hallucinosis, a high degree of delusional acceptance, a low degree of thinking, a high degree of emotion, a low memory, is greatest in REM sleep. I'm only saying greatest—98% will do for me, I don't need a hundred. I can easily handle day-dreaming, which is, I think, what you're talking about. But when I daydream, it's true that I lose self-reflective awareness, but I don't hallucinate. I think that hypnotizable subjects can do that, but I can't. I can imagine things, and it's a lot of fun to imagine. I don't hallucinate. I don't have eight-by-eight-inch boxes with rattlesnakes in them. It just doesn't happen. If I did, they'd probably lock me up.

Question: If it is true that people have had experiences of being considered brain-dead and then have regained consciousness, and then they say, "Well I was up on the ceiling watching the surgery and you all thought I was dead," and they can remember what was being

said. How does that correlate with your saying the mind and the brain have to be on at the same time?

Hobson: Well, I think that we'd have to look very carefully at the physiological evidence for death. You're mixing two stories there, both of which are interesting. In one case, you pose the question, the subject is dead; in the other case, the subject is undergoing surgery, and is under anesthesia, and is thought to be unconscious, but later reports details of the procedure and of the surgeons' talk. That doesn't strike me as difficult to explain.

Now if you told me that the EEG was flat for ten minutes, there was no heartbeat, and then the subject aroused and said, "All that time I could see you, you were trying to get my EKG," and gave me a veridical report of what I had been doing to try to resuscitate, I'd be damned impressed. But I haven't heard those stories. I have heard the anesthesia stories in abundance. They don't strike me as odd. The anesthetists are not the slightest bit interested in consciousness.

I had one of these carpal-tunnel things done. And they gave me what was supposed to be a local anesthetic. And they had a tourniquet on my arm, and I got goofy as hell, and I told them, I said, you know I'm really feeling quite disoriented, and delirious in fact. The novocaine was going through the tourniquet into my brain. They weren't the slightest bit interested. So most of the anesthesiologists are paid not to have lawsuits brought against them. And they're not particularly good academic colleagues. They probably need to attend one of your seminars.

Question: I have a question for you. When you were talking about dreams being visual—have you done any studies on people who were blind from birth, and how do they dream?

Hobson: We haven't done them, but they were done in the early days, so you have to be careful—they probably should be done again. If you are blind from birth, you don't have any visual experience, so you have no way of reporting out visual experience. If you have acquired blindness, however, you have the engrams, all the visual experience that you had before you were blinded. And they dream visually with great pleasure because they see people that they otherwise could not see. It's a very nice point for psychotherapy. They should be taught to access their dreams. You can learn to access your dreams better. It's a lot of fun, actually. But the short answer is, blind from birth, no; acquired blindness, yes.

Question: I think, in one way, Dr. Hobson has proven that Korzybski was very wrong in one thing he said. Those of you who were at some of the seminars at Lakeville will remember, perhaps, certain concepts coming up, and Korzybski saying with great vehemence, "Psychiatrists—hopeless cases, absolutely hopeless."

Dr. Hobson: "I would tend to agree with that, I would tend to agree." [audience laughter]

[Editor's Note: Korzybski was famous for making highly critical statements about philosophers, which may be one reason why Martin Gardner (a philosophy student at the time he attended Korzybski's lectures) became so dead-set against him; but this is the first time I have heard that he made vehement statements against psychiatrists. Korzybski had great respect for the field of psychiatry, and studied psychiatric patients with his close friend, Dr. William Alanson White, at St. Elizabeths Hospital, for two years in the 1920s. He also had numerous contacts with professional psychiatrists throughout his life, and said that the average person should probably be under the care of a psychiatrist. He worked closely with Dr. Douglas M. Kelley and Dr. Douglas Campbell, psychiatrists who were prominent students of his.

Of course, we know that Koryzbski was

fully capable of insulting anyone, if so inclined; but without knowing the particular circumstances of Korzybski's remarks, and given the length of time since Korzybski made them, I would tend to 'think' that it is at least *possible* that the questioner has confused Korzybski's remarks about philosophers or psychologists with psychiatrists.

Korzybski sometimes used quotes when referring to philosophers or psychologists, e.g., 'philosophers', 'psychologists'; but his critical assessment of the 'psychologists' of his day did not extend to those scientists working in the field of experimental psychology, as I interpret his writings.]

Questioner continues: One quick question about the poem. It's the first poem about the mimic. Who was that, was it Pope, or who?

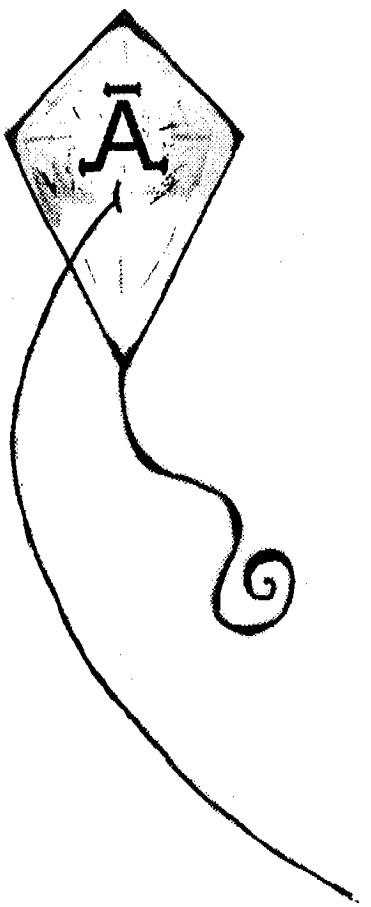
Hobson: No, it's Dryden. And then the second one is Swift, and they're nearly contemporaries. Swift is the better known of the two; but nobody gets them. It's funny that the 18th century has been forgotten. The 18th century was a time of very imaginative rationalist thinking. I mean they weren't just squares who were thinking linearly. They were very imaginative people. And both of those poems are very nice, I think. They summarize what we found.

Thanks for coming. Thanks for staying awake!

Jeff Mordkowitz: Let's thank Dr. Hobson very much for a wonderful talk.

Dr. Hobson's 1994 book, *Sleep and the Chemistry of Conscious States*, was named a *New York Times* Notable Book. In his 1999 book *Consciousness*, Dr. Hobson explored the brain structures/functions now understood to be fundamental to conscious experience.

—Susan Presby Kodish, Ph.D.



A Non-Aristotelian Kite