THE PASSIONATE MIND: BRAIN, DREAMS, MEMORY, AND SOCIAL CATEGORIES

by Robin Fox

Abstract. The intellectualist position held by structuralists does not explain the extremes of emotional reaction to the disruption of social categories. An approach from neuroscience based on the functions of the limbic system in the creation of long-term memory through the role of the hippocampus and REM sleep is proposed to account for the emotive loading of cognitive categories.

One of the briefs offered to participants in the 1984 Star Island Conference of the Institute on Religion in an Age of Science was to examine the findings of Claude Lévi-Strauss and the structuralists in light of the findings of neuroscience. I shall attempt to do this, but my attempt is not primarily directed at questions of myth and ritual; it seeks rather to understand the neurological base of what lies behind a good deal of myth and ritual, namely, social categories. By extension, it must deal with categories per se, but since the stress in anthropology since Emile Durkheim has been on the social origins of categories and since this stress is what has inspired the anthropological study of myth and ritual, I here concentrate on social categories by way of illustration of the thesis. And the thesis is really very simple: if one may paraphrase John Locke, there is nothing in the memory that was not first in the emotions.

At first glance this may not seem so startling, but it runs quite counter to the assumptions and indeed the overt statements of the structuralists. Victor Turner, in whose honor the conference was held, had come to realize this late in his anthropological career and was about to launch on an ambitious program of rethinking to right the record. His tragic death robbed us not only of a good friend and a great anthropologist, but also of a chance to see where he would go from his

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[*Zygon*, vol. 21, no. 1 (March 1986).]
 ISSN 0044-5614

promising start on the relations between the structure of the triune brain and some aspects of ritual (Turner 1983). I am approaching from a slightly different angle, but we cover a lot of similar ground. A great deal of the material I draw on was not available to Turner since it comes from the latest research of Jonathan Winson, and not all of this was published (Winson 1985). Also, it would not necessarily have been obvious from what was published that there was an immediate relevance to the subject in hand. I shall try to make the connection as best I can.

Categories, Dreams, and the Emotional Brain

I first made the point in chapter seven of *The Red Lamp of Incest: An Inquiry into the Origins of Mind and Society* (1983), but I had not at that juncture got the Winson argument quite right.[1] I shall attempt to make good the deficiency here. I was trying to make a connection between evolution, memory, dreams, and social categories. My starting point was the structuralist assertion that we do not view the world, or act upon it, directly in the way animals do; rather, we act upon it through the medium of social categories which define for us what falls into one class and what into another, and how to act towards each set of "objects" so classified. The structuralists were not the first by any means to make this observation, and it has a venerable history in philosophy—and a strong modern influence through Ludwig Wittgenstein—as well as a firm place in the history of anthropology through the influence of Benjamin Lee Whorf and his followers. But it is a point central to the arguments of the structuralists whom we have been asked to consider. Lévi-Strauss, for example, seems to accept that there is a basic, appetitive drive to classify (Lévi-Strauss 1963), but he regards the act of classifying and the consequent behavior as purely acts of the "intellect"; indeed he pours scorn on those who would hold an "emotive" view of, say, totemism and urges us, in the title of the penultimate chapter of his book on that subject, "Vers l'Intellect" (Lévi-Strauss 1962, chap. 4). This, I believe, is one of the many Cartesian-type dichotomies in social theory that bedevil us and that neuroscience may help to eliminate. For an "intellect versus emotions" dichotomy can only be translated into a "prefrontal cortex versus limbic system" dichotomy, and, as I hope to show, this simply does not jibe with what we know of the role of these parts of the brain in the creation of categories.

Let me first of all insist, however, that I totally accept the structuralist premise that we view and act on the world through our acquired categories. This is not what is at issue. Where I part company is when this fact is used to remove us from the process of evolution and the state of nature. It does neither. It is an evolutionary development like any

other—a very powerful one from the point of view of adaptation. Clearly any discussion of it belongs in the general discussion of the evolution of language. This is not because acting in terms of categories is unique to a language-using animal. Any long-term observation of chimpanzees, for example, would leave one in no doubt that they act upon such categories as opposed to acting "directly" upon reality. But even if the difference is one of degree, the degree is so great as to be rightly regarded as another level of action with truly emergent properties. When linguistic labeling enters, the whole picture changes. But I do not want to linger on this point since it would get into a long discussion of whether we can be said to be acting on the basis of social classifications even if we do not have words for them ("unconsciously") and that is not part of my problem. Whether we need the labels or not, we must enter the categories into long-term memory. It is here it seems to me that neuroscience can come into the picture and, while accepting that action in terms of coded social categories is a defining human characteristic, can explain the mechanisms by which this is made possible and suggest the probable evolutionary origins.

The structuralist argument is in line with the general theory of the social determinants of perception.[2] The categories by which we classify the world and through which we act upon it are socially derived and hence differ from society to society (or culture to culture, whichever you prefer). I have always been at the center of this debate since, as an expert in "kinship systems," I have been constantly faced with the argument that kinship has nothing to do with biology because kinship terms—the classifying categories of the kinship universe—do not designate true genetic relationships but indicate socially determined roles and statuses. This is true, but it does not follow that such systems have nothing to do with biology unless one defines *biology* narrowly as meaning "designating true genetic relatedness." Since it is indeed a wise child that knows its own father it would be rather remarkable if kinship terms did do this. What they in fact more probably designate are categories of prohibited and preferential mates—and that has a lot to do with biology (Fox 1979)! But it is certainly true that we act towards individual kin according to the category designation and not directly. If a total stranger to whom we had been quite indifferent were to be revealed as a "brother," our attitude would certainly undergo a significant change as he was shifted from the one category to the other. As Durkheim saw, these categories cannot stray too far from objective reality (or "nature") without serious consequences (Durkheim 1915, 18-19). Thus, what foods will be defined as polluting will differ from group to group, but no group can define *all* foods as polluting without starving to death. This was not Durkheim's example (he did not give

any), but I think it illustrates what he meant. And it is not a bad place to start since pollution and totemism—both central to many theories of religion—have been prime examples of the structuralist point. Thus Mary Douglas uses different classifications of "pollutants" to show how society indeed determines what people will find "dirty" and what not. Her famous dictum that dirt is "matter in the wrong place" beautifully sums this up (Douglas 1969; 1973; see also Leach 1964). After numerous discussions with neighbors who are passionate gardeners and hence horrified with my survival-of-the-fittest approach to plants, I have come to define a "weed" as a "flower in the wrong place." But note that passions are here aroused.

This brings me to the first sense of disquiet with structuralism in its approach to categories. Edmund Leach has expressed the same disquiet, although he too holds firmly to the Durkheimian doctrine. In questioning Lévi-Strauss's self-avowed "intellectualist" approach to totems, Leach notes that, while it is true that the universal function of totemism (the naming of social groups after animals and things in nature) may well be simply intellectual (part of a desire to "order out the universe" as E. B. Tylor [1899] put it), nevertheless, people do get very emotional about the things they categorize. The question, says Leach, is why is the totem so often taboo (Leach 1964; 1970)? Why should the categories evoke such passionate responses? The answer that he and Douglas give to this question was implicit in my anecdote of the weeds. People become upset when their established category systems are disturbed. Polluting things, obscene things, dirty things, suspicious and evil things, uneatable things, and so on, are all things that disturb the established category system—the socially derived system of classifying the world. But then the question still remains: if the classifying function is purely intellectual—simply part of a desire for order—why the powerful reactions of disgust, horror, unthinkableness, and even homicide, when faced with what should be simply an intellectual disruption? One can imagine perhaps minor irritation and even some anxiety over a disruption of an established category system; but accusations of witchcraft and beating to death? I think one can be forgiven for believing that something else is going on here that is only uncomfortably accommodated within the category "intellectual." Lévi-Strauss is willing to go as far as "anxiety," and in a little-read footnote in *Mythologiques: L'homme nu* he actually looks for a physiological basis for this anxiety (lactic acid) (Lévi-Strauss 1971, 588). But reactions range from mild anxiety to homicidal passion, and this is still puzzling if the original intellectualist premise holds. That Lévi-Strauss should invoke a physiological mechanism at all is interesting, because it suggests a wired-in mechanism to deal with category disruptions. If this is so, what does it suggest about the creation of the categories in the first place?

It is here that we must turn to neuroscience, and we must turn also to an area of neuroscience that has been neglected because a simple connection has not been made. The category systems of which we speak—the vast and complicated systems of social classification—"exist" in the mind, of course, but more particularly they have to have been entered, as we saw, into the long-term memory storage which is indispensable to the mind's functioning. Naturally, not only linguistically coded social categories enter this storage system but, if something is true of *whatever* enters it, then it will be true also of such categories and hence may give us a clue to the question in hand: Why the heavy emotional loading in a supposedly unemotional and purely intellectual system?

Let us then examine the long-term memory process in as simple a way as is possible given its obvious technical complexity. To this end a simplified diagram may help. Diagram 1 shows, topologically, the relationships between the areas of the brain that are involved in memory processing. It is based on one designed by Vernon H. Mark and Frank Ervin who note that all the areas so associated are also those associated with emotion: the so-called limbic areas or limbic system. The crucial organ which makes the connection is the hippocampus. The hippocampus, like the other structures of the limbic system, does not receive direct sensory information, but rather a higher level of abstracted and processed information from various areas of the cortex—the thin (one-tenth of an inch), convoluted tissue which surrounds the limbic area. This "acquired" information is gathered in the cingulate cortex or cingulate gyrus and transferred, via the cingulum, to the hippocampus. It then passes via the fornix to the hypothalamus, thence to the thalamus and back to the frontal lobe of the neo-cortex. When, how, and why does it make this journey? Let us start at the beginning.[3]

One major function of the hippocampus is short-term memory processing. People with hippocampal lesions literally cannot remember anything from one moment to the next. They live in an eternal present. But for our purposes, more significant is the role of the hippocampus and the rest of the limbic system in long-term memory. Those with hippocampal lesions, while unable to remember any recent experiences, repeatedly show that they can remember events that occurred three or more years ago. Thus is has been shown that it takes three years for experiences to enter long-term memory. Once entered they are very resistant to loss (as experiments with electroconvlusive therapy have proved), but we still do not know why some are resistant to conscious recall. Nor, for that matter, are we certain how they are stored. But of the processing of input for storage we now know a great deal.

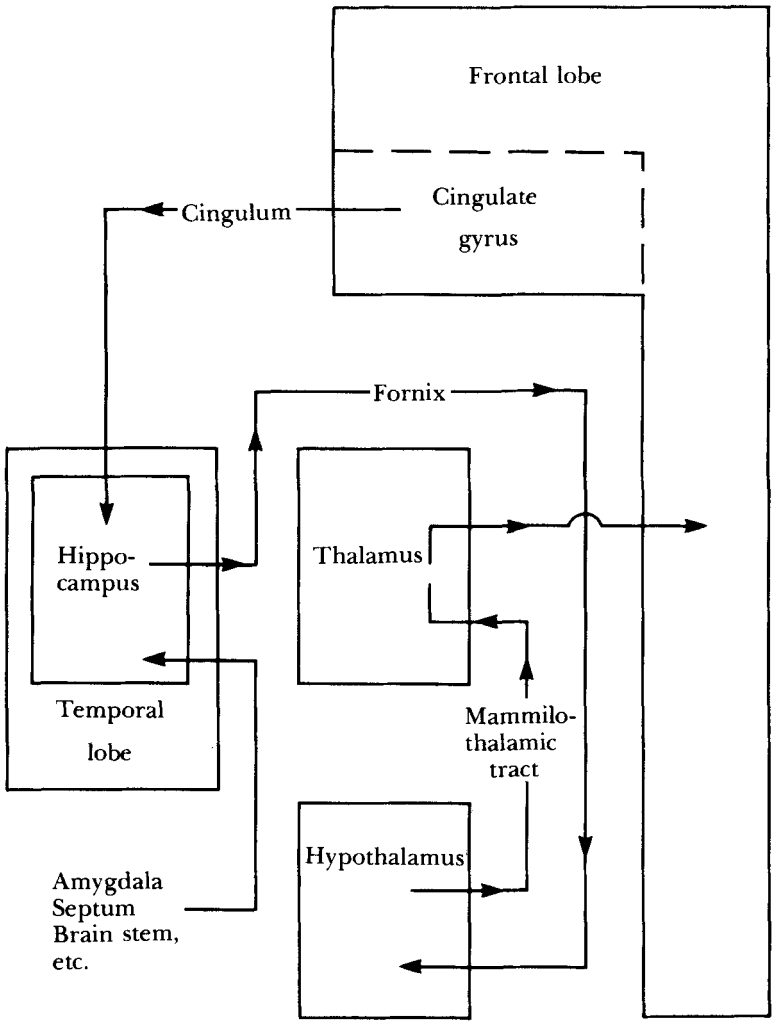

DIAGRAM 1.—Schematic representation of the memory circuit (based on Mark & Ervin 1970, 142).

It turns out that the hippocampus is as important here as in short-term memory. This was first discovered in animals in the following way. During the waking state, and when performing species-specific behaviors of crucial importance to the species' ethogram (burrowing in rabbits, exploring in rats, pouncing in cats, etc.), the animal exhibited certain highly distinguishable brain rhythms (EEGs) that were designated theta rhythms. This was interesting enough, but it was then found that during REM sleep these same theta rhythms reappeared.

Now REM sleep (rapid eye movement sleep), as we have all come to know, is what we commonly call dreaming. In an average eight-hour sleep period there are usually four such intervals during which the eyes move rapidly although there is no other body movement. All brain centers are active at this time, and this conjunction of total body immobility and totally active brain caused the French researchers of the phenomenon to coin the delightful term *sommeil paradoxal* or paradoxical sleep. There is no body movement (although there may be minor twitches and "intention" movements that you can easily observe in your sleeping pet) because the brain stem effectively shuts off during this period thus preventing the translation of the cortical activity into motor activity. (Sleepwalkers may have some minor deficiency of this mechanism.)

What is going on here? Well, dreaming of course, but what is this process? Why in animals are the theta rhythms reappearing during dreaming? Winson discovered a remarkable process he terms *neuronal gating* (Winson 1985, chap. 8). It is too complex to discuss in detail, but again it takes place in the hippocampus. During the waking state, neural gates in the hippocampus remain closed, but once sleep begins they begin to open, letting chemical material circulate around the lamellae (the disc-like components of the hippocampus) and out to various parts of the limbic system. At the deepest point of sleep, REM sleep, the last gate opens and the theta rhythms appear. This is repeated roughly four times per night. Human subjects, too, report dreaming only during the REM period, although dreamlike states can precede and follow it. Humans, however, do not show theta—a point to which we must return; but for the moment let us stay with the animals. Repeated experiments have again shown that animals deprived of REM sleep fail to remember tasks from one day to the next. We can at this point even jump to the theta-less humans since they show the same results: memory deficits resulting from REM sleep deprivation. So one conclusion is obvious: whatever else dreams are doing, they are serving as a processing system for memory; and this processing system is located in the hippocampus and its limbic connections. The hippocampus can handle short-term memory, but for anything to enter long-term memory it has to be processed (i.e., dreamed) for at least three years in some form or other. Experiments have shown that during this process the synapses—connections between neurons that carry the "information"—actually grow and harden into habitual pathways thus facilitating the rapid processing of memory.

But this processing is taking place, as we have seen, during dreaming when in animals the distinctive theta rhythms occur. We can only speculate here, but it does seem that what is happening in REM sleep

for animals at least is that current information, blocked from the hippocampus and the limbic circuit during waking, is allowed in there during sleep to be "matched" against those wired-in survival behaviors that are the species' ethogram—its record, if you like, of successful adaptive behavior. If they are "passed" as being relevant, then they are shunted on through the rest of the limbic circuit to be, in the graphic words of G. A. Ojemann, "stamped in" to the long-term memory, and eventually stored in the neo-cortex (Ojemann 1966). Without this information the neo-cortex could not perform its essential function of assessing experience in order to make plans and goals for future action.

And here may be the clue. There is no way in which the neo-cortex could store *all* the information it receives without becoming so large that, as Winson says, we would need a wheelbarrow to carry it around in. Also most of the current information is not relevant to survival functions. In humans who suffer certain deficiencies (I suspect in the neural gating mechanism), the tendency to remember everything proves totally debilitating and self-defeating: they cannot function. And, if Sigmund Freud called schizophrenics "waking dreamers," he may have been uncannily near the truth since it could be that their neural gates are not working either (being perhaps deficient in a necessary inhibitor from the brain stem during the waking state) and that a process is going on with them continually that should only take place during REM sleep. But that is to speculate beyond my brief. In any case, we have a dramatic discovery here. Let us put it this way: memories must be dreamed to be retained; this involves their vetting or appraisal by the brain's emotional system; only certain material will be passed into memory; the process takes three years to complete—three years of intensely emotional dreaming.

Evolution, Language, and Representability

Winson's point about brain size and memory storage has an equally dramatic illustration in the brain of the echidna or spiny anteater. Along with the duck-billed platypus this is the last of the surviving monotremes: the egg-laying, warm-blooded creatures that emerged from the reptiles more than sixty million years before true marsupials and mammals. Reptiles have no REM sleep and precious little by way of brain; their brain stem carries in it enough information for most of their needs. Mammals do have REM sleep and the combination of limbic system and cortex that we have discussed. As we go up the phylogenetic scale the brain-body ratio goes up accordingly, and the size of the neo-cortex increases reaching its highest ratio in Homo sapiens. But there is a remarkable fact discovered as long ago as 1902 by Grafton Elliot Smith who was rightly puzzled by it: the small echidna

has a neo-cortex as large as ours (Winson 1985, 56, 257n)! It is a primitive pre-mammal, only a move from the reptiles (in evolutionary terms) yet with an enormous neo-cortex. (To be exact, we are talking of a particularly large, pre-frontal cortex.) It would have remained a mystery without the discovery of one vital fact: the echidna has no REM sleep; it does not dream.

The pieces fall startlingly into place. The growth of the neo-cortex and limbic systems was essential to "mammalian" evolution—the step beyond the reptiles. Paul D. MacLean describes the reptile as "doing what it has to do," while the mammal can in varying degrees "do what it plans to do" (Turner 1983, 244 n. 16). To achieve this it needs an efficient memory, and the neo-cortex is obviously the repository of memory since the echidna, in its behavior, is not that much different from a low level mammal. But obviously there came an evolutionary point beyond which the neo-cortex could not simply go on growing indefinitely in order to store memory, and the amount it could store at the echidna level was limited. Evolution could have stopped there (and probably did for many millions of years) until the incredible breakthrough of REM sleep, or dreaming. What evolved was a *selective processing device* that enabled recent memories to be evaluated against the "phyletic" memories of the species, and giving them time in which to be so processed and evaluated. They would be passed through the limbic (emotional) circuit while the animal was immobilized, then "tagged" and passed on into memory storage which was thence not burdened with the necessity of containing everything from current memory but only the most "emotionally" significant (i.e., that with survival value).

What about the lack of reappearance of theta in human dreams? This may well extend down into the primates—it has certainly not been reliably reported in higher primates—and may therefore represent an equally significant new departure in that evolutionary line culminating in the remarkable abilities of humans. Again this is speculative, but what seems to have happened is that dreaming in the higher primates has been freed from the tie to the phyletic past to some degree. While human dreams obviously reflect many features deep in our phylogenetic experience (archetypes?) and are subject to the same emotional "loading" process as other mammals, we may be freer to mix recent memories with old experiences in a process of evaluation not as open to lower mammals. These older experiences, for reasons I will go on to explain, may be primarily related to the period of brain growth from conception to completion, that is, pre-natal experience and childhood. This "uncoupling" of memory from too close a tie to species-specific experience may be the most crucial of breakthroughs since the invention of REM sleep itself.

To summarize then, let us repeat the maxim we invoked at the beginning: There is nothing in long-term memory that was not first in the emotions. And in a very particular way: via dreaming. Social categories, for example, totems or kin terms, are stored in long-term memory. Very often societies use a particular process we commonly call "initiation" to "educate" young people in the more explicit social categories of the group. While initiations serve many functions, this educative element with its often graphic and traumatic teaching mechanisms is obviously important; and it may represent one way in which the social wisdom is transmitted by evoking dramatic images and instilling them by repetition and often quite frightening rituals. The dreams and nightmares thus produced, often over a period years, will do their work of lodging the social categories pretty well.

But, it might be objected, when it comes to it, these explicit social categories are words and these are what are remembered. It is not that clear. Of course the words are remembered because words are sounds and sounds are remembered. But memory existed long before speech, and dreams are always visual scenes. When speech came along to be remembered, Winson postulates, then what Freud called the "need for representability" in dreams arose: the speech had to be translated first into a visual image before the memory process could work on it. Hear Winson:

> This may be a direct result of the phylogenetic origin of the brain mechanism I have postulated. Language, and abstract concepts derived therefrom, played no part in the lower mammalian brain. The limbic-frontal cortical system governing interpretation of experience and planning operated solely as the basis of action and this remains the case in man. Thus, abstract concepts arising with language, which are a large part of our experience, can only be integrated into our unconscious brain mechanism by translation into visual scenes and actions—giving rise to the witty, fascinating and difficult to translate components of dreams Freud identified as transformed by the need for representability (personal communication).

The implications of this fact are mind boggling. For example, if categories have to be "re-represented" as images, then how much more economical and powerful if they are couched in imagery to start with? This theory would make totemic categories far more intelligible than any of the theories Lévi-Strauss dismisses, but also more intelligible than his own "intellectual" version. Yet it would tie in. Totems are not simply as in his formula "good to think" because they are metaphors (should we say metonyms?) drawn from the natural world to classify the social world, but because they are "good to remember." They have presented to the hippocampus and the limbic circuitry a graphic image on which to work in REM sleep, not simply a word or abstract concept. They have contributed from the start—as kangaroo, emu, snake or

eaglehawk—to the need for representability; and as such they have been open to the emotional vetting system which has, during three years of activity, stamped them in. Is it any wonder then that they have a heavy loading of emotion and that a "disturbance" of the conceptual system so set up will cause a strong emotional reaction? To understand how the concepts got into long-term memory is to accept their "intellectual" function, but it is also to understand how this cannot be dissociated from their "emotional" function. Indeed it makes the distinction an analytical one rather than anything in the "real" world. Categories are "good to think" because they are "good to remember," and they are good to remember because the emotional brain has been able to represent them in REM sleep—to dream them into memory. Totems, according to the Australian Aborigines, were laid down in the "dreaming"—the period in which the world and people were originally created. Their own formulation may then turn out to be nearer the truth than the tortuous analyses of the anthropologists. (Obviously some categories are remembered better than others, and some evoke more emotion; and this needs investigation. I would suggest that those categories that are laid down in early childhood, that are taught either consciously or unconsciously by those methods of initiation involving traumatic but ultimately triumphant—becoming a full adult—processes, will have the most emotional loading and will evoke the strongest responses. But to spell this out would be another article.)

Metaphor, Language, and Memory

We have seen then why, to answer Leach's question, the totem is so often taboo (although not always, because sometimes the totemic categories are not laid down in the severe manner described above), but what about less dramatic categories like "time" for example? The position of the structuralists and the Whorfians is much alike on this in that they demonstrate the relativity of notions of time, showing how these are socially derived (i.e., characteristic of a culture, not innate or invented by an individual) and how they vary so that no two cultures seem to view time in quite the same way (Whorf 1956, Durkheim & Mauss 1963). What is more, again, people can become quite upset when confronted with a disruption of their time categories—by people from another culture for example. But let us consider: How do we eventually integrate such seemingly abstract notions into our long-term memory? It has to be through representability, and indeed the whole language of time that a child learns is not one of abstract concepts but of vivid metaphors. Lewis Carroll used this to great comic effect with time being "beaten," "wasted," and so on. But this is exactly how we talk of it. Time "marches on"; like the tide it waits for no man; time "flies"; we

"run out of" time and we have "time outs"; time is an "old father"; there can be a vital "nick" of time; time "presses"; time is "short"—one could go on almost endlessly. But what is this presenting to the emotional circuitry—an abstract, intellectual concept? Not at all. It is a series again of graphic metaphors, a "prepackaging" if you like of representability for the hippocampus to seize upon and turn into graphic material for dreams. Thus a growing child will develop not an abstract and bloodless "category of the intellect" but a many-layered emotional notion of time rich in metaphor and associations and loaded with emotional content in its three-year journey through the circuitry. Again this needs to be explored further, and I can do no more here than suggest the possibilities. But it is an interesting point where cultural anthropology, linguistics, and neuroscience can meet amicably for once and not waste time on time-consuming disputes.

The implications of this approach go deep into the nature of language itself, and that would be going too far perhaps. But I cannot help thinking that the despised theories of language of the first great cultural anthropologist (Ibn Khaldun was perhaps the first great sociologist) might be seen in a different light. Giambatissta Vico (1668 to 1774) was totally neglected in his day; and although he has had something of a revival recently, his theory that the original speech of man was poetry is still smiled at. Yet what he was saying, as Isaiah Berlin lucidly points out, was that what we call metaphorical speech was the original speech of the human race, and as late as the *Iliad* this was still the case. "Ploughs actually appeared to have teeth, rivers, which for them were semi-animate, had mouths: land was endowed with necks and tongues, metals and minerals with veins, the earth had bowels, oaks had hearts, skies smiled and frowned, winds raged, the whole of nature was alive and active" (Berlin 1980, 97-98). Thus they thought in pictures, and like the Neanderthals in William Golding's *The Inheritors* they translated their images into rudimentary expressions conveying the images. What this could be is not the famed "primitive mentality" of totally mythopoeic thought, nor the right hemisphere of the brain giving orders to the left, but simply a necessary phase through which early language had to pass since it intruded into a neural world where it had not been; and in order to be remembered, without which it could not function, it had to pass through the ancient mammalian memory circuit which demanded visual representablity. What "early language" then would be, would be a language of metaphor that was intimately close to the process of memory. Again I suggest this for the possibilities of exploration—particularly of preliterate languages. But, as we have seen with "time," our own is not immune from the early influences. Of course, the hippocampus will provide the representability even if we do

not appeal directly to it with metaphor, but it is tempting to think that before the curse of literacy we were more in tune with our unconscious processes, as the poets still are (we suppose).

Memory, Mismatch, and Emotion

Let me clear up a couple of technical points before either going further astray or concluding. I have said that with the "uncoupling" from theta, human dreaming could function by referring present information to past experiences rather than directly to ancient phyletic memories. In this way ontogenetic learning could become stored and built upon with an efficiency not known to other mammals (except, but to a lesser degree, our primate cousins). In this context early learning becomes especially significant because it takes place during critical periods when the very structure of the brain is being laid down. One of these periods, that between six months and fifteen months, seems to be especially crucial since it involves the coincidence of two processes: the dramatic "fear of strangers" and "fear of separation" response in behavior, and myelination of the fiber bundles which are the essential "pathways" of the limbic circuit, which is both the emotional and memory circuit, as we have seen.

Let us back up for a moment and come into this by another route which will return us eventually to our original question of the emotional disturbance felt over the disruption of intellectual categories. In a series of brilliant experiments, various ethologists and animal behaviorists worked out what has come to be known as the "mismatch" theory of fear responses in very young animals (Eibl-Eibesfeldt 1982, chap. 10). Thus, it was noted that chicks ran fearfully to their mothers when they saw the shadow of a hawk on the ground. At first it was thought that the shape of the hawk was a "releaser" of innate fear responses, but later experiments showed that what the chicks in fact responded to was not specific shapes but any major *discrepancy* in shape that they encountered. If one habituated them to the hawk shape, they showed a fear reaction when a goose shape was introduced. The Canadian psychologist Donald Hebb had advanced the same theory in a famous paper describing the behavior of young chimpanzees (Konner 1982, chap. 10). He suggested that it was not the intrinsic nature of the objects that caused the fear reaction, but the degree of discrepancy between them and other similar objects with which the infants were familiar. He argued that the brain was somehow designed to generate fear as a result of such a "cognitive mismatch." But *how* is the brain so designed, and what is the neural source of the fear? (Minor discrepancies, by the way, only arouse "alert" behavior: the major ones provoke fear.) We now know from human (and primate) infants that there is a

definite developmental stage at which this "mismatch fear response" occurs: it is between six and fifteen months and seems to be at its peak at about twelve months. This "fear curve," Melvin Konner reports, coincides with the period during which the major fiber tracts of the limbic (emotional/memory) system are receiving depositions of myelin, which "sheath" them and allow them to work with maximum efficiency. Up to this point they have been growing, and the infant has no discrepancy mechanism. After this point (six months) they become rapidly "fixed" and the fear reactions can begin to work (Konner 1982, 225).

The tracts involved are the fornix, connecting the hippocampus with the hypothalamus; the mammilothalamic tract, connecting the hypothalamus with the anterior nucleus of the thalamus, and thence with the cerebral cortex; and the cingulum bundle, connecting the cortex with the hippocampus. If the readers will refer again to diagram 1 they will see that these are indeed the major connecting pathways of the limbic circuit.

That fear of discrepancy or "mismatch" should set in when the myelination process is as its height is extremely suggestive. What it suggests to me is that this may be one of those crucial early "experiences" that lays down the basis for the extremes of "mismatch phobia" that we are discussing under the heading of emotive reactions to the disruption of (social) categories. The dream-memory process in future years will have a major reference back to this established fear base—as opposed to the apparently automatic reference back to theta-associated behaviors in the nonprimate dreaming mammals. Konner, who reports all this, was not concerned with our problem and knew nothing of Winson's hypothesis. But hear him on infant "mismatch":

> From several lines of evidence it is now fairly clear that the hippocampus . . . is involved in the process of comparing newly presented perceptual configurations with those already stored in memory. The report of a mismatch to the arousal-fear mechanisms of the hypothalamus would thus almost have to involve the hippocampus and its major fiber bundle, the fornix. Thus the ability of human infants to repond to perceptual discrepancy from an established schema, known to increase as the brain grows during the first year, may be in part dependent on the myelination of the fornix. One can visualize, for example, that the approach of a stranger to the infant at twelve months of age might occasion a rapid "filing through" of the faces stored in the infant's memory (a process that would involve the hippocampus and fornix) followed by the reporting out of a mismatch (Konner 1982, 225).[4]

He goes on to observe that the cingulum bundle is what neurosurgeons lesion in cases of severe phobia. We can, on the basis of what we know of the preservation of information in long-term memory, extrapolate forward from this to the dreaming, memorizing, and categorizing adults, whose fiber tracts in the limbic system are completely intact and

who have therefore a complete phobic mismatch arsenal at their disposal.

Conclusion

This, as I said, brings us round full circle to our original question addressed to the structuralist intellectual theory of social categories. Insofar as these are a function of memory and especially of long-term memory, then they cannot escape a heavy "emotive" content. Indeed the distinction ceases to be very real; it only makes "analytical" sense to distinguish between certain "mental" processes such as getting angry on the one hand and deciding that two and two equals four on the other. This is a reasonable enough distinction perhaps, but it becomes dangerous when we foist it on to the real world—like associated distinctions of nature and nurture, mind and body, or individual and social. If anyone still doubts that this is so, then perform this little experiment. Insist, calmly and rationally, to another calm and rational person that two plus two does not make four, and persist, with smiling reasonableness, that this is the case in the face of all rational objections. But I would advise not persisting for too long, for I confidently predict that your companion will become quite emotional in one way or another about your refusal to accept the "obvious." Why should it matter? Because even such a seemingly "pure" intellectual statement like "two plus two equals four" is so heavily loaded in our category system with feelings of "rightness," of "truth," of "proof," of "logic" and "reasonableness" that any persistent denial will cause a severe emotional reaction. A "logical," "sane," "reasonable" person cannot deny this established categorical system of mathematical certainty so rooted in our notions of how the world is ordered. It was the genius of George Orwell (and I am writing this in 1984 after all) that saw that the *ultimate* test of Winston Smith's total mental surrender to Big Brother did not lie in his betrayal of his lover. The rats and the betrayal were a means to the end of having him finally accept, without any mental or emotional reservations, that two plus two equaled five.

NOTES

1. I think I am closer to Winson's true argument in this paper than I was in *The Red Lamp of Incest* (1983), but in chapter seven ("The Matter of Mind") I go into more detail than is possible here on the question of the theories of totemism, for example, and the problem with the Durkheimian theory of social categories which I try to resolve in an evolutionary framework.

2. The best contemporary discussion is in Berger and Luckman (1967). It is interesting in view of the anthropological insistence on maintaining the nature-culture dichotomy (which Victor Turner was so anxious to break down) that they conclude that the tendency to so structure the world must be a "basic feature of the organism."

3. The following is my own interpretation of Winson's argument, and I am responsi-

ble for any errors or misunderstandings. The necessary references can be found in Winson (1985).

4. Striking confirmation of Konner's hunch about the ability of the brain to "file through" a series of remembered faces comes from the work of, among others, Perrett and Rolls (1983), which shows that primate neural mechanisms exist in specific regions of the temporal lobe which are specialized to process the complex visual patterns of faces.

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