BRAIN ROOTS OF THE WILL-TO-POWER

by Paul D. MacLean

Abstract. The human brain has evolved to its great size while retaining the anatomical and chemical features of three basic formations that reflect an ancestral relationship to reptiles, early mammals, and late mammals. Such considerations must be taken into account in the origin and expression of individual and collective violence, which operationally depend on power and the orchestrated use of power. Aristotle and Friedrich Nietzsche have respectively provided paradigms of a "great-souled man" and a "superman"—both basically ruthless. In neurobehavioral investigations of the triune brain, one finds the basis for the hierarchical development of ruthless power, merciful power, and transcendental power.

Not long ago one of our diplomats said that he regarded the possession of power as the ultimate satisfaction. This seems like a distant echo of what Friedrich Nietzsche wrote 100 years ago when he described the joy of the superman, who, through his will-to-power, has the satisfaction of realizing himself as part of the eternal recurrence. Nietzsche explained that this revelation about the superman first occurred to him near that "holy spot," Sils Maria, in the Swiss Engadine "six thousand feet beyond man and time."[1] It was shortly afterwards that Zarathustra began to pour out of him. As though he had discovered nature's greatest secret, he concluded that the will-to-power is the basic life force of the entire universe. "Thus life taught me," he wrote.[2]

Although the mention of Nietzsche's revelation may stir up unpleasant memories of vitalism, it serves historically to point up the discomfort of our continued preoccupation with questions about life that we still do not know how to ask. In this respect, a theoretical physicist has

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recently queried, "Might not life have a more important role in cosmology than is currently envisioned? That is a problem worth thinking about. In fact, it may be the only problem worth thinking about."[3]

In the light of such considerations we may ask metaphorically regarding one aspect of life, "What is the will-to-power? From what does it spring? Why is it more forceful in some individuals than in others?" In these times one does not need to be an ethologist to realize the importance of power in animal interactions. The English naturalist Eliot Howard, in his classical study of territory and bird life, put his finger on one aspect of power when he observed that a male bird must establish and protect a piece of territory if it is to be successful in attracting a mate.[4]

In looking for the origins of the will-to-power we must, as in the case of other psychological matters, turn our attention to the anatomy and functions of the brain. After reviewing some recent developments regarding the evolutionary brain roots of power, I will briefly discuss the question of why we, as mammals, seem to lack the safeguards, particularly in large groups, against a primitive regression to the irrational and violent use of power. As Arthur Koestler reminds us, we have more to fear because of collective violence than violence of individuals, especially when we are swayed by demagogic leaders who use the masses to satisfy their own driving needs for power.[5]

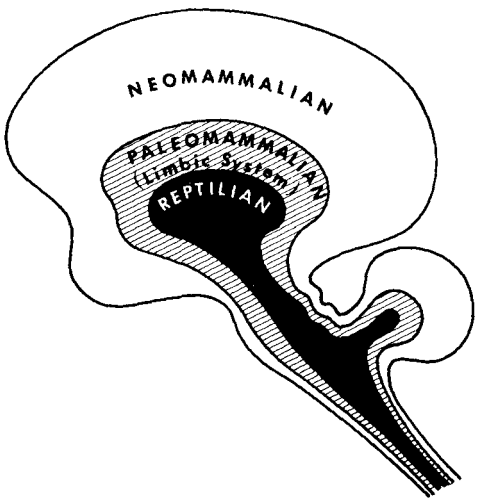

FIG. 1.—The triune brain. In its evolution the primate forebrain expands along the lines of three basic formations which anatomically and biochemically reflect an ancestral relationship, respectively, to reptiles, early mammals, and late mammals. The three formations are labeled at the level of the forebrain which may be regarded as the psychencephalon. (From P. D. MacLean, "The Brain in Relation to Empathy and Medical Education," *Journal of Nervous and Mental Disease* 144 [1967]: 374.)

Comparative studies, together with an examination of the fossil record, indicate that the human brain has evolved and expanded to its great size while retaining the features of three basic evolutionary formations that reflect an ancestral relationship to reptiles, early mammals, and recent mammals (see fig. 1). Radically different in their structure and chemistry, and in an evolutionary sense countless generations apart, the three formations constitute a hierarchy of three-brains-in-one—a triune brain.[6] This situation suggests that our psychological and behavioral functions are under the joint direction of three quite different mentalities. For us as human beings there is the added complication that the two older formations do not have the power of speech.

Our experimental work indicates that the deepest roots of power can be traced to the reptilian formation, which, for short, I will refer to as the R-complex.[7] The later developments (the paleo- and neomammalian formations) greatly extend the options for the use of power and the expression of power.

The Reptilian Complex (R-complex)

Let us look first at the R-complex. Recent developments in histochemistry have been invaluable for identifying corresponding parts of

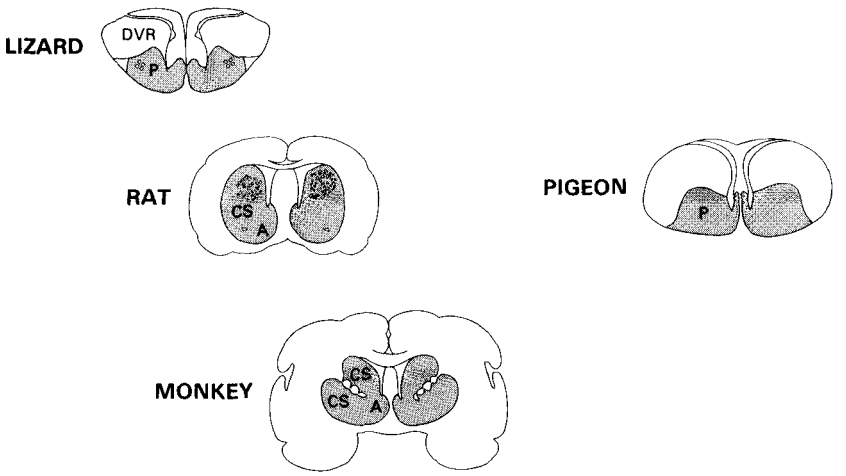

Fig. 2.—Picture obtained upon applying a stain for cholinesterase to brain sections of a lizard, rat, monkey, and pigeon. Combined with other evidence, the stain reveals that the striatal complex is a common denominator of the basal forebrain of terrestrial vertebrates. With the histofluorescence technique, the main part of the complex glows a bright green because of the presence of dopamine. (Redrawn from A. Parent and A. Olivier, "Comparative Histochemical Study of the Corpus Striatum," *Journal fur Hirnforschung* 12 [1970]: 75, with substitution of lizard for the turtle.)

the R-complex in reptiles, birds, and mammals. Two examples will suffice. Figure 2 illustrates that a stain for cholinesterase sharply demarcates the R-complex in these three classes of animals. Altogether, the R-complex comprises structures known as the olfactostriatum, corpus striatum, globus pallidus, and satellite gray matter. Using the histofluorescence technique of B. Falck and N.-A. Hillarp,[8] one finds that the bulk of the R-complex glows a bright green because of the presence of dopamine, a neural sap that seems to be requisite for bringing into play the total energies of the organism.

A study of the fossil record has made it possible to trace back our genealogy to the therapsids, the mammal-like reptiles living 250 million years ago, a duration of time equivalent to 10 million human generations. These therapsids existed long before the dinosaurs. They widely populated the earth in large numbers when it was but one continent, Pangaea, including the part that later broke off as Antarctica.[9] Some species had a likeness to dogs and wolves. In body carriage and in structure of the jaws and teeth, the advanced forms closely approached the condition of mammals.[10]

For comparative studies it is unfortunate that there are no existing reptiles directly in line with therapsids. Of existing types, lizards would probably bear the closest resemblance to the mammal-like reptiles, with the giant Komodo dragon perhaps being the best prototype (see fig. 3).[11]

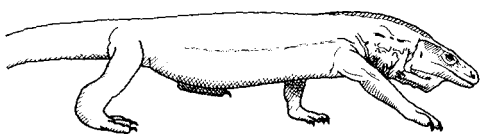

FIG. 3.—Display of a Komodo dragon. The close-in agonistic display of an adult Komodo dragon is similar to that of an appeasement display of a juvenile shown here. The animal walks slowly in a stiff-legged, stilted manner. The angle of the right forelimb in this picture is reminiscent of the goose step. Note three static modifiers seen in other lizards—namely, elevated roach (nuchal and dorsal crests), extension of gular fold, and sagittal expansion. (From W. Auffenberg, "Social and Feeding Behavior in *Varanus komodoensis*," in *The Behavior and Neurology of Lizards*, ed. N. Greenberg and P. D. MacLean, Department of Health, Education, and Welfare Publication No. [ADM] 77-491 [Washington, D.C.: U.S. Government Printing Office, 1978], pp. 301-31.)

In analyzing the behavior of lizards one can identify more than 25 forms of behavior that are also characteristic of mammals.[12] Those notably lacking in lizards are nursing in conjunction with parental care, play, and audiovocal communication (except notably geckos). This behavioral triad characterizes the evolutionary dividing line between reptiles and mammals. It is commonly assumed that all four-footed vertebrates vocalize, but this is not so for most lizards, and the same

may have been true of the mammal-like reptiles. In our carnivorous therapsid ancestors two small bones of the jaw joint were gradually becoming smaller, but they had not yet migrated to become the malleus and incus of the highly tuned mammalian ear.[13] Hence, there is evidence that the therapsids were hard of hearing and were possibly mute like most existing lizards. Consider, here, a great difference between reptiles and mammals. The isolation call appears to be characteristic of all mammals. It may be the most basic vocalization because it served originally to maintain maternal-offspring contact and, later on, contact of members among a social group.[14] Separation of a suckling from its mother is calamitous. Contrast this situation with that of lizards which may cannibalize their young. The young of the Komodo dragons, for example, must escape to the trees for the first year of life in order to avoid being cannibalized, while the hatchlings of rainbow lizards must hide in the deep underbrush.[15] For the latter to utter an isolation call would invite disaster.

Neurobehavioral Findings. In clinical neurology it has been traditional to regard the R-complex as part of the motor apparatus under the control of the motor cortex of the new brain. Our experimental work, however, indicates that the R-complex may have *a mind of its own*. It seems to be a brain that is essential not only for organizing the daily master routine and subroutines but also for giving expression to four main types of communication that we share with other animals.[16] Here I will consider its role in social communication because this topic brings us back to our main concern with brain roots of the will-to-power. Lizards are ideal for illustrating four main types of display that show up in one form or another in reptiles, birds, and mammals. In lizards these displays are referred to as the (1) signature, (2) challenge, (3) courtship, and (4) submissive displays. Of these, it is the challenge displays that are of central interest.

As illustrated in figure 4, the challenge displays incorporate the dynamic components of the signature display (namely, head bobs, push-ups and an extension of the colorful throat fan) together with static components which, like a football uniform, make the subject appear larger in size. The challenge displays are used chiefly by territorial males in establishing territory, maintaining dominance within a group, and fending off invaders. Utilizing an experimental approach that does not interfere with thermoregulation, we have found that partial destruction of the R-complex, but not of other parts of the forebrain, results in the failure of territorial male lizards to perform the challenge display.[17] Similarly, in a long-term study on squirrel monkeys I found that destruction of the medial pallidal segment of the R-complex, or its

projecting pathways, eliminates or alters a particular signature display that has features in common with the challenge display.[18]

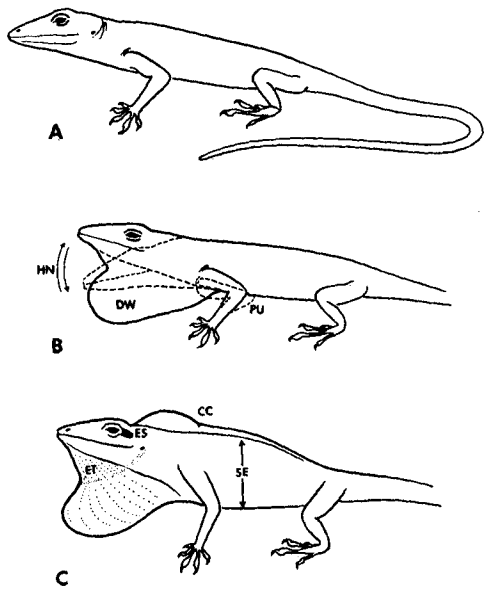

FIG. 4.—Features of the signature and challenge displays of the common green anolis lizard (*Anolis carolinensis*).

A. The usual attentive posture.

B. Diagrammatics of the signature (assertion) display. The signature display consists of three to five head nods (HN) and pushups (PU), along with an extension of the dewlap (DW). The broken lines indicate the excursion of the head and flexion of forelimbs during pushups. Note absence of static modifiers.

C. Diagnostic features of the challenge display of adult male lizards. In addition to the dynamic components of the signature display, the challenge display has several static modifiers of which the first to appear are the extended throat (ET) and sagittal expansion (SE), followed by an elevation of the nuchal and dorsal crests (CC). A darkly pigmented eyespot (ES) may appear after two to three minutes. See text for further details. (From N. Greenberg, P. D. MacLean, and J. L. Ferguson, "Role of the Paleostriatum in Species-Typical Display Behavior of the Lizard [*Anolis carolinensis*]," *Brain Research* 172 [1979]: 229-41.)

Comment. The experiments indicate that in animals as diverse as lizards and primates, the R-complex plays a basic role in the expression of displays used in communication. The close-in challenge display of lizards compares to the broadside display of many mammals, particularly with respect to the sideways presentation and walking with awkward, stilted steps. The grizzly bear, for example, will present itself sideways to a challenger and, like lizards, walk in a wobbly, stilted manner.[19] I had been unaware that the broadside display of the gorilla resembled the challenge display of lizards until I saw Dian Fossey

mimic the sideways presentation of a silverback and its walking with wobbly, stilted, steps.[20]

The stilted, staccato steps of the challenge display seems to carry the message of a series of exclamation marks, calling to mind the goose step of a military parade and the similarity in profile to the challenge display of the Komodo dragon (see fig. 3). In view of these persisting similarities, it would almost seem as though the challenge display has been genetically packaged and handed up the phylogenetic tree of mammals.

Among lizards, the spoils usually go to the animal of largest size. But L. T. Evans and others have shown that size is not the only factor in winning a contest.[21] The territorial lizard on its home ground appears to hold advantage over an intruder. Recalling what takes place in a political arena, it also may be the number of displays rather than size per se, that decides the winner in a combat. Roger Masters found that in two recent presidential campaigns the winner had been displayed in a greater number of pictures than the loser.[22] As D. Morris has commented, it often happens in telephone communication that it is the number of rings rather than the loudness of the ring that brings the party to the phone.[23]

The Paleomammalian Brain (Limbic System)

With the evolution of mammals there appears to have come into being the primal commandment: "Thou shalt not eat thy young or other flesh of thine own kind."[24] The later commandment, "thou shalt not kill," is inherent in the primal commandment. If, however, one were to select three outwardly expressed forms of behavior that most clearly distinguish reptiles from mammals, the triad would consist of (1) *nursing*, (2) the *isolation call*, and (3) *play*.[25] Play might be interpreted as promoting cohesiveness and harmony in the nest and social affiliation later on.[26] Experiments to be mentioned later indicate these three forms of behavior depended on evolutionary developments in the paleomammalian formation of the brain.

As illustrated in figure 5, most of the "old" cortex identified with early mammals is found in the great limbic lobe which constitutes a common denominator in the brains of all mammals.[27] This cortex, together with the structures of the brainstem with which it is connected, comprises the so-called limbic system, a term that I suggested in 1952.[28] Clinical and experimental findings of the past forty years indicate that the limbic system derives information in terms of emotional feelings that guide behavior required for self-preservation and the preservation of the species.[29]

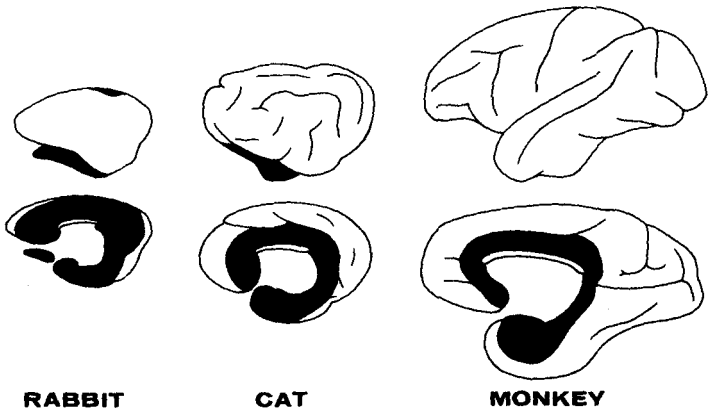

FIG. 5.—Location of cortex of the paleomammalian brain (limbic system). The evolutionarily old cortex is largely contained in the limbic lobe of Broca (shaded) which forms a common denominator in the brains of all mammals. The cortex of the neomammalian brain (shown in white) mushrooms relatively late in evolution. (After P. D. MacLean, "Studies on Limbic System 'Visceral Brain' and Their Bearing on Psychosomatic Problems," in *Recent Developments in Psychosomatic Medicine*, ed. E. Wittkower and R. Cleghorn [London: Pitman & Sons, 1954], pp. 101-25.)

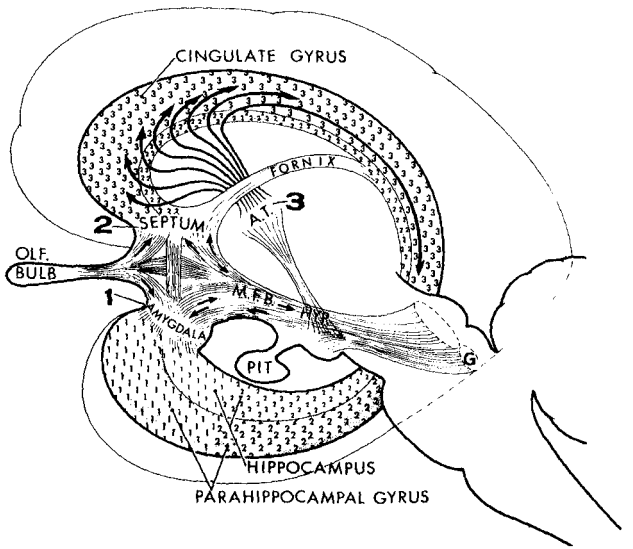

FIG. 6.—A brain map of three main subdivisions of the limbic system and their major pathways identified by the overlying numbers. See text for summary of their respective functions. Abbreviations: AT, anterior thalamic nuclei; G, dorsal and ventral tegmental nuclei of Gudden; HYP, hypothalamus; MFB, medial forebrain bundle; PIT, pituitary; OLF, olfactory. (After P. D. MacLean, "A Triune Concept of the Brain and Behavior," in *The Hincks Memorial Lectures*, ed. T. Boag and D. Campbell [Toronto: University of Toronto Press, 1973], pp. 6-66.)

As diagrammed in figure 6, the limbic system can be subdivided into three main subdivisions. The first two, marked #1 and #2, are closely related to the olfactory apparatus. The subdivision marked #1 has been shown to be involved in behavior concerned with self-preservation—namely, feeding, fighting, and self-protection—while the second division, marked #2, participates in primal sexual and other procreative functions.

Upon stimulation of the amygdala region in monkeys one may elicit first oral manifestations such as licking and chewing, followed many seconds later by the appearance of penile erection.[30] The reverse sequence may be obtained by stimulating in the septal region or related structures accounting for penile erection.

The presentation of full penile erection is one of the manifestations of signature, challenge, and courtship displays of squirrel monkeys.[31] Penile erection is also a manifestation of aggressive displays in other primates, including chimpanzees.[32] As illustrated in figure 7, if one uses the shield of Mars for plotting brain loci at which electrical stimulation elicits oral responses and his sword for genital responses, one finds a reconstitution of the warrior at a locus in the hypothalamus that is crucial for the expression of angry behavior.[33] The intimate relationship between oral and sexual functions in these parts of the brain is apparently due to connections with the olfactory apparatus which, dating far back in evolution, plays a primary role in both feeding and mating, as well as in the fighting that may precede.[34] In this close overlapping of structures involved in oral and sexual functions we gain insights into brain mechanisms that account for sadistic and masochistic behavior. The close tie-in of these same circuits with brain mechanisms involved in the expression of fear also may help account for vicarious sexual arousal in pyromania, reckless driving, fear-inducing sports, and the like.[35]

Animals with large olfactory apparatus mark their territories with urine. The message, so to speak, is "stay away." On the other hand, as already mentioned, a number of primates use the visual display of the genital as part of their aggressive displays. In mythology the erect genital is often associated with protective powers, but the opposite situation applies to the god, Pan, who enjoyed scaring strangers—a circumstance to which we owe our word "panic."[36] Amulets showing an erect phallus have long served as a protection against the evil eye. From time immemorial, house guards showing an erect phallus have been used as territorial markers.[37] People continue to draw phallic representations in public toilets and to leave their names or initials as a kind of marker.[38] Periodically, adolescents go on the rampage displaying their nakedness in public. I. Eibl-Eibesfeldt has described a genital display

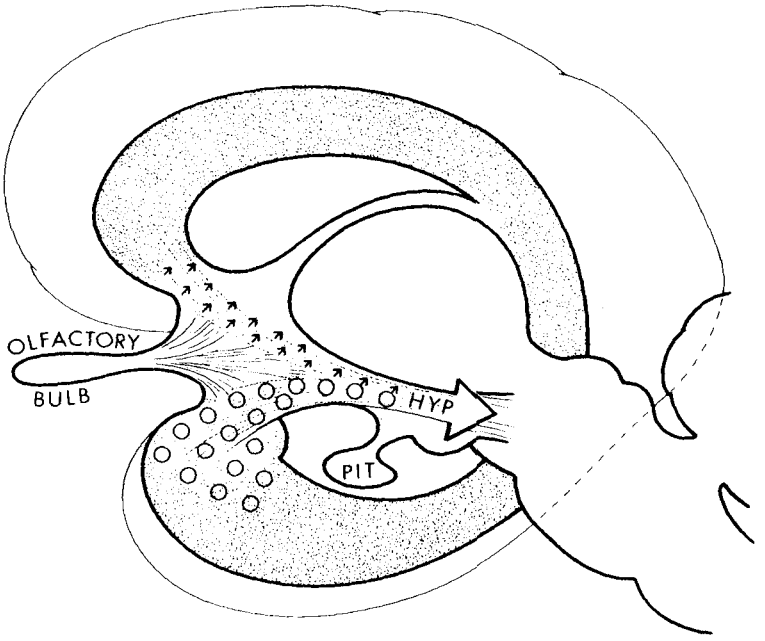

FIG. 7.—Diagram summarizing effects of electrical stimulation at points within the two subdivisions of the limbic system interconnected respectively by amygdala and septum (cf. fig. 6). The shield of Mars (0) is used as a symbol for facial, oral, and alimentary responses and his sword (♂) for genital responses. Symbols are for shield cluster in amygdala region, and those for sword in septal region. Followed along descending pathways, sword and shield unite in the anterior hypothalamus, portraying a reconstitution of the warrior Mars at a locus where electrical stimulation elicits angry and defensive behavior. See the text for implications. (From P. D. MacLean, "A Triune Concept of the Brain and Behavior," in *The Hincks Memorial Lectures*, ed. T. Boag and D. Campbell [Toronto: University of Toronto Press, 1973], pp. 6-66.)

among bushman children that compares to the genital display of squirrel monkeys.[39] Vandalism at schools and elsewhere represents another form of visual marking that is perhaps of a sadistic nature.[40]

We turn next to the third subdivision of the limbic system (see fig. 6) for which there appears to be no rudimentary counterpart in reptiles and which reaches its greatest development in the human brain. It is perhaps this subdivision of the limbic system which more than any other accounts for the differences between reptiles and mammals—particularly in connection with maternal behavior, play, and emotional forms of vocalization, including the isolation call.[41] It will be noted that the main pathway of this subdivision bypasses the olfactory apparatus. Data are now accumulating that the visual system may have an important influence on this subdivision. Several workers have found that damage to the cingulate cortex interferes with maternal behavior.

D. Ploog and others have shown that the anterior cingulate cortex is involved in the production of vocalizations, including the isolation call.[42] I and my colleagues have conducted other relevant experiments. By a manipulation at the time of birth we can prevent the entire neocortex from developing in hamsters. Despite that loss the animals engage in *all* forms of hamster-typical behavior, including mating, breeding, and rearing of the young.[43] However, if in addition the cortex of this division is destroyed, young animals do not play and there are deficits in maternal behavior. It was as though these animals had regressed towards a reptilian condition.

To give emphasis to the role of the R-complex and limbic system in expression of the basic animality is not to downplay the importance of the neocortex. The neocortex mushrooms progressively in higher mammals (cf. fig. 5), reaching its greatest development in human beings. Nothing is more neurologically certain than that the neocortex is necessary for language and speech and that we owe to it the infinite variety of ways in which we can express ourselves.[44]

Before some final remarks regarding the neocortex, let me make two points about, first, the function of the cortex in general and, second, the exacting condition of being a mammal. First, it is generally taught that the cerebral cortex accounts for learning and memory. Animals such as reptiles with a rudimentary cortex are regarded as stupid learners. But let it not be forgotten that they are able to learn their territories inside out, to recognize strangers at first sight, and so on. In addition to learning the invention of the cortex made it possible to accomplish what is often a prerequisite, namely, the ability to *unlearn* what the species has learned to do over millions of years. Under many circumstances it is essential to unlearn an old ingrained response before learning something new. Withholding the tendency to panic that occurs in a burning building is a case in point. With the evolution of the limbic system and neocortex there appears to have been little built-in machinery to deal with run-of-the-mill activities and emergencies that have been under the management of the reptilian formation for millions of years.

The second point is that, except for matters concerning family and language, it would seem that the limbic and neocortex have few wired-in programs and none in particular for dealing with situations involving large numbers of individuals. The adoption of a family way of life appears to have put the mammal in a bind with respect to crowds. Even herd animals tend to group as families. When people do meet in large numbers, they seem to do best in situations in which they are feeding together, as at feasts and music festivals or, taking advantage of the mammalian trait of play, as in local, national, and international games,

including the Olympic Games. However, here again there is a primitive, child-like, fine line between having fun at play and getting mad and fighting. Just within the last few years we have seen the Olympic Games become a leverage for terrorists as well as a political means of displaying national will in showdown situations.

The mention of politics raises the important question concerning the topic of this issue of *Zygon* and the prevalence of violence. It needs to be emphasized that often the worst kind of violence hinges on the choice of national leaders, who more than anyone have the will-to-power and the position of power to foment worldwide violence to satisfy their own needs as paranoid supermen. We worry a lot in this country about individual violence, but as Koestler reminds us, "The damages wrought by individual violence for selfish motives are insignificant compared to the holocausts resulting from self-transcending devotion to collectively shared belief-systems."[45] Franklin Roosevelt once said, "We have nothing to fear but fear itself." Living in his time, he could just as well have said, "People have nothing to fear but their choice of leaders."

In Nietzsche's superman we hear the echoes of Aristotle's "Great Souled Man," who being so far superior to other human beings "is justified in despising other people." Similarly, Nietzsche's superman had the draconian right of riding roughshod over other people.[46] As his sister helped to explain, "All that proceeds from power is good, all that springs from weakness is bad."[47] Such assertions, however, must be evaluated in the light of the realization that it was we who were driven out of Eden by the great apes, and it is we, the meek, who have inherited the earth.[48]

The Neocortex

The psychopathic ring of Nietzsche's superman reverts our attention to the neocortex—a neomammalian development that mushroomed late in evolution and achieved its greatest proportions in human beings. The neocortex is oriented primarily to the external world and seems to serve as a kind of problem-solving and memorizing device to aid the two older formations of the brain in the struggle for survival. With its focus on material things, the neocortex develops somewhat like a coldly reasoning, heartless computer. It is the kind of computer that has the capacity to devise the most violent ways of destroying our own kind as well as other forms of life. As though foreseeing that a terrible genie was in the making, nature enlarged that part of the neocortex which for the first time in the world brings a sense of concern for the welfare of all living things. In the rapid progress from the Neanderthal

to Cro-Magnon people, the human forehead develops from a low brow to a high brow. Significantly, the expanding prefrontal cortex underneath establishes connections with the third great subdivision of the limbic system—that concerned with parental care (see fig. 8). The prefrontal cortex is the only neocortex that has strong connections for sensing the inside world. There is clinical evidence that the prefrontal cortex, by looking inward, obtains the gut feeling required for empathic identification with another individual. This is the second "big news" about the evolution of mammals. It is this new development that makes possible the insight required for the foresight to plan for the needs of others as well as the self, and to use our knowledge to alleviate suffering everywhere. In creating for the first time a creature with a concern for all living things, nature accomplished a 180-degree turnabout from what had previously been a reptile-eat-reptile and dog-eat-dog world.

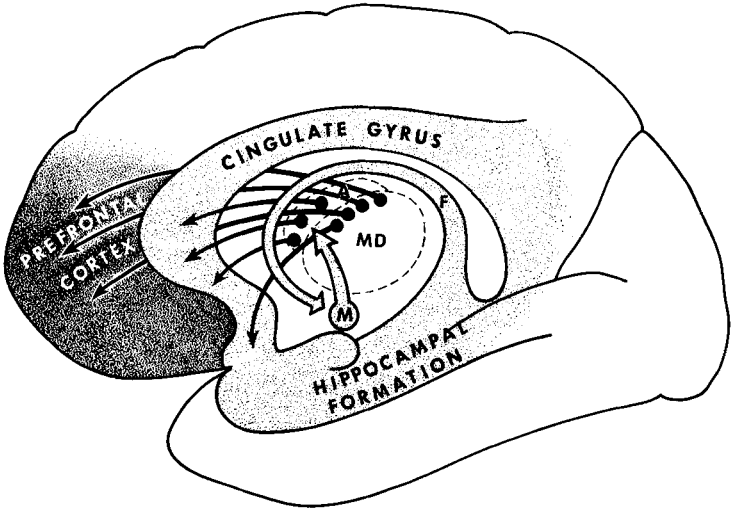

FIG. 8.—Limbic-prefrontal connections. The diagram indicates how the limbic system (light stipple) and its third subdivision (cf. fig. 6) is anatomically related to the prefrontal cortex through the articulation of their thalamic nuclei. Abbreviations: F, fornix; M, mammillary bodies of hypothalamus; MD, medial dorsal nucleus; A, anterior thalamic nuclei. (From P. D. MacLean, "The Brain in Relation to Empathy and Medical Education," *Journal of Nervous and Mental Disease* 144 [1967]: 374.)

It is presumed that we humans had our big brains for thousands of years before we developed a language of words, and it is only 2,000 years ago that we first saw the empty space—the zero—between our fingers that gave us a workable language of numbers.[49] In addition to this we have acquired the transcendental language of the golden rule

that gives us the power to bend and shape our inherent, selfish will-to-power. Keeping all these things in mind, we may well afford to strive—not to become just supermen and superwomen—but rather to achieve our great potential as human beings.

NOTES

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2. F. Nietzsche, "Thus Spoke Zarathustra," in *The Portable Nietzsche*, trans. W. Kaufmann (New York: Viking Press, 1968), pp. 191-259.

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