A New Experimental Animal for Psychiatric Research: The Opossum, *Didelphis virginiana*

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THE opossum, *Didelphis virginiana,* is a commonly occurring native marsupial. Opossums are easily handled and maintained in captivity. The opossum has received wide use in endocrinological, embryological, anatomical, and neurological research, but has received no attention as a valuable experimental animal in psychiatric research. The opossum spontaneously exhibits a catatonic-like response to threatening stressful stimuli. The components of this response are seen in the total performance of the opossum and also in the central nervous, autonomic nervous, gastrointestinal, cardiac, respiratory, urogenital, somatic muscular, and special sensory systems.

Exposure of the opossum to a threatening stressful situation initiates the following sequence, in which all the components are present to a greater or lesser degree, depending upon the individual animal and its previous experience. First there is exaggerated, if not inefficient, somatic muscular action in an attempt to escape, with some of the animals making a low growling sound and snapping. This initial and not invariably present phase of hyperactivity is marked by a rapid heart rate, increased rate and depth of respiration, defecation, occasionally urination, extrusion of a foul smelling yellow green material in a fine spray from the perianal region, periorbital muscle tension, and a drawing back of the angles of the mouth. The initial hyperactive phase is of short duration, from a few seconds to five to ten minutes. This hyperactive phase is often so transitory as to be almost absent.

In the second or catatonic phase, the animal becomes semirigid and usually assumes a posture of lying on one side with the limbs partially extended, the mouth open, and the tongue slightly protruded. The limbs may be flaccid or rigid at various times while the animal is in this catatonic-like state. The heart rate is decreased and the apical impulse is often impalpable. The respiratory movements are slowed and predominantly abdominal. Frequently they are so slight that the abdominal or thoracic movements cannot be detected. Following periods of stimulation or stress, while in the catatonic state, the opossum may exhibit periods of apnea for 30 sec or more. There is greatly increased salivation, with a pool of watery saliva forming about the animal's mouth. The mucous membranes become pale and dry. The animal may continue to defecate while in this state, each succeeding stool becoming more watery. The tendon reflexes are usually absent, as is sometimes the corneal reflex. The cremasteric reflex has invariably been present. In the latter part of the initial hyperactive phase and the early part of the retarded catatonic phase, the eyes may show rapid lateral nystagmoid movements; the limbs may show a rapid and gross tremor, most marked in the hind limbs. If held up by the skin of the dorsum of the neck during this period, the animal assumes a posture with the mouth agape, the tongue protruded, the forepaws clenched together, and the hind limbs extended laterally with gross muscle tremor. The eyes do not close, although the lids may move close together. During the catatonic-like state, the animals do not respond to painful forced flexion of the fingers, rough bodily manipulation, tactile stimulation, irritation of the nasal vibrissae, and stroking of the cornea.

The opossum may show both active and passive negativism, as described in the criteria of animal catatonia of deJong (*1*). In a long catatonic state the animal may respond to auditory stimuli, especially if the sound is loud, low-pitched, and sudden. Olfactory awareness, as evidenced by wriggling of the external nares, often persists while the animal is in the catatonic-like state.

At any time, depending upon as yet unknown intraorganismic factors, the opossum may suddenly reintegrate and make attempts to escape. This is most likely if the animal is suddenly exposed to a new and major stimulus. The opossum also may gradually reintegrate when placed back in the safety of its cage, but diminished awareness may persist for an hour or more.

The animals may remain in the catatonic-like state for as long as 2 to 6 hr, or only for several minutes. In their cages the opossums may show immobility in an abnormal position for many hours after being stressed. This state may even be induced repeatedly in the same animal on the same day, with longer or shorter periods of catatonia. However, the opossum becomes less likely to exhibit the catatonic-like response as it gains experience with either a particular stress situation or a particular experimenter.

The value of the opossum as an experimental animal in psychiatry lies in the fact that it spontaneously exhibits a catatonic-like syndrome which illustrates all the concomitants of the catatonic syndrome seen in man in psychopathologic conditions. Not only do these states occur spontaneously in the opossum, but they also may be induced with test stressful situations with quantification of total performance of the organism and evaluation of component system changes. The opossum experiences this state in the absence of the administration of pharmacologic catatonia-inducing agents (such as bulbocapnine or mescaline), and thus avoids the contamination of the experimental situation from both the performance and the physiologic point of view. The opossum is also characterized by a primitive, "olfactory," nervous system with rudimentary neopallial structures, thus lending itself to experimentation directed towards the elucidation of the functional effect of phylogenetically old structures in the mammalian brain.

Reference

1. DEJONG, H. H. *Experimental Catatonia: A general reaction-form of the central nervous system, and its implications for human pathology.* Baltimore: Williams and Wilkins Co., 1945.

The Principal Characteristics of the Formation of the Earth's Crust

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As THE QUESTION of the shape of the earth was a much disputed one several hundred years ago, so is today the question of its surface pattern. But while celestial mechanics has provided ample explanation for the gross appearance of our planet, the majority of contemporary geologists and geophysicists are still in want of a mechanism that would account for the principal characteristics of its crust. Many attempts have been made to explain different formations by assuming processes peculiar to a given case, but there has been little success in the efforts to harmonize this multiplicity of proposed mechanisms and to give a unified physical picture of the history of the outer shell of the earth. Yet a careful look at a physical map will reveal certain regularities in the structure and distribution of the continents, oceans, and mountain chains, and will lead one to believe that, although the existence of a multiplicity of particular mechanisms is unquestionable, there must have existed a dominant process exerting a determining influence on the formation of the principal features of the terrestrial surface.

Various processes have been ascribed such a dominant role. Of the more important ones, the shrinking of the planet, the separation of the moon, and the migration of continents (*1, 2*) should be mentioned. The first two processes seem far from furnishing a satisfactory explanation for many prominent features of the earth's surface pattern. As to the third one, a large amount of material in the field of geology and related sciences has been gathered by Wegener (*2*) to substantiate the hypothesis. However, despite the fact that a large part of the data appears to be in perfect agreement with this hypothesis, it has failed to gain general acceptance, largely because it does not provide for the mechanism that would satisfactorily explain the relative displacement of continents. If we are to decide on a process as playing a dominant part in the formation of the earth's crust, we ought to choose one that would best agree with the principal characteristics of this formation and for which a plausible mechanism could be established.

As a first step, then, an attempt has to be made to collect those characteristics of the formation of the earth's crust that could be regarded as the principal ones. Failure in the past to differentiate between the chief and the secondary features, as well as limiting the considerations to the findings of but one discipline, has led to the formulation of theories that can often be applied only to a very restricted number of data, although they appear plausible when taken by themselves. Later we shall consider a mechanical concept that suggests itself from our findings as a suitable explanation for all of the enumerated characteristics.

Astronomy has shown that the nearly spherical shape of the earth is not an exceptional phenomenon. This shape differs but little from one of several well-known figures of equilibrium for a fluid mass that is isolated in space. Thus, the assumption that the earth once was in a fluid state became a highly probable one. As with every liquid celestial body, it should have been covered by a crust in the process of cooling. This crust would take the form of a spherical shell if there were no rotation. In case a slow rotation should take place, the crust would become an ellipsoidal shell of small ellipticity. The earth, however, being a member of the solar system, was never an isolated mass. Its path in space during the three billion years of its history was a very complicated one, owing to the existence of external forces such as the attractions exerted by other members of the solar system. This fact makes impossible any situation that would correspond to the exact conditions of equilibrium. Even now, when a larger part of the body of the earth seems to be solidified, tidal deformations in the crust produced by the moon and sun are considerable.

However, external gravitational forces are not the only factor disturbing the mechanical equilibrium of the earth. In fact, there is no trace of mechanical equilibrium in any known fluid celestial body. Such a state is sometimes assumed, but only in order to simplify a theory. In the process of cooling, a temperature gradient is set up between the surface of a celestial body and its interior. Thermal equilibrium becomes