ment would predict that his jet stream ought to be a warped sheet of high-velocity filaments lying everywhere along this complex line in a representative meridional plane.

We see nothing at all in his bewildering report that sheds light on, or even relates meaningfully to, jet streams in the mid-latitude westerlies.

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Behavior: Confinement, Adaptation, and Compulsory Regimes in Laboratory Studies

A few generalizations emerging from ethologically oriented laboratory studies of wild rodents have important bearings on the rationale and design of experiments on learning and reinforcement. Depriving animals of natural outlets for activity by confining them in small and barren enclosures greatly influences their behavior. Thus, when given the means to modify their environment in ways that do not subject them to great stress, captive rodents exercise this control repeatedly (*1*, *2*). These animals find it rewarding to attain and to exercise a high degree of control over their environment, perhaps in partial substitution for the freedom of action enjoyed in the wild but denied by confinement. Accordingly, rodents repeatedly turn on and off (or otherwise modify) any suitable variable placed under their control, whether it is intracranial stimulation, a motor-driven activity wheel, lights or sound, or whether it is merely the ability to visit a nest, run a wheel, jump on and off a platform, patrol an enclosure, traverse mazes, or gnaw wood into fine fibers.

The initial responses of rodents in laboratory enclosures do not reflect the preferences or behavior of animals adapted to the experimental situation, but rather those of animals forced to endure unnatural and completely arbitrary conditions and schedules of confinement and experimentation. The time required for animals to adapt to the "insults" of laboratory experimentation is measured not in minutes or hours but in days or weeks (*1*, *2*). Thus, even in experiments for which the design and analysis do not penetrate beyond regarding the animal as a convenient experimental machine or black box, the responses to daily short experimental sessions generally give information only about the initial, and often rebellious, reactions of the "machine" to abnormal and enforced working conditions. Only studies over long periods permit the delineation of adaptational from adapted behavior.

When a confined animal is exposed to arbitrary or unexpected changes in environment or regime, but is provided with the means for counteracting these changes, it typically does so. For example, if the experimenter turns on a motor-driven activity wheel in which an animal is forced to run, but which the animal can turn off, the animal immediately and invariably turns the motor off (*1*). Conversely, if an animal is running a motor-driven activity wheel that it has turned on itself, and the experimenter turns the motor off, it immediately turns the motor back on. Similarly, if a light is periodically turned on by the experimenter and the animal can operate a stepping switch which steps it off by degrees, the animal generally steps it fully off (*1*). If, instead, the experimenter periodically turns the light off, the animal, even though nocturnal, often steps the light fully on. Only after weeks of this full opposition to arbitrarily imposed conditions does the animal adapt to the regime and adjust the changed light intensity to a characteristically preferred low level, rather than merely to the opposite extreme of the imposed condition.

Thus, taken alone, the nature of a specific stimulus (or activity) is an unreliable guide for interpreting the behavior of small mammals given control over its initiation or cessation, or both, or forcefully exposed to it. Stimuli which are rewarding or punishing in certain circumstances have the opposite effect under other conditions (*1*, *2*). The seemingly enigmatic findings on self- and non-self-initiated intracranial stimulation and on the effects of shock on learning and avoidance (*3*) no longer are paradoxical when the effects of subjecting experimental animals to compulsory regimes and of greatly limiting their control over their environment are taken into account.

Using such atypical species representatives as domestic rats and mice for laboratory studies of behavior narrows the animal response spectrum to a point where its significance for adaptation, survival, and evolution becomes highly questionable. These selectively inbred animals are hundreds of generations removed from the wild. Their bland behavior tells us mainly how animals react to experimental regimes after many of the characteristic adaptive responses of the species have been largely or completely lost. Domestic animals remain convenient vegetalized strains for physiological studies, but only wild animals provide the full range and vigor of responses upon which solutions to the central problems of behavior must be based.

Important advantages to the use of wild rodents stem from their extraordinary capacities to learn complex contingencies and to gain detailed familiarity with a vast laboratory "habitat." Mice of the genus *Peromyscus* have mastered programs in which seven different manipulanda involving four different functions were in use concurrently (*2*). These animals also learn their way through burrow-simulating mazes of unprecedented complexity—containing hundreds of blind alleys—without extrinsic reward (*4*). There is no reason to believe that these remarkable feats even approach the limits of the learning capacity of the wild animal, although they far exceed the performances of domestic rodents. The animals readily learn to distinguish the functions of several identical manipulanda. Accordingly, identical levers can be used both to initiate and terminate environmental and activity changes, and they can be located at many positions and their functions interchanged and rotated, bringing this variable under close experimental control.

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References and Notes

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27 December 1963