The instinct versus learning controversy once revived by Lehrman's critique of Lorenz's theory has subsided, yet the issue seems to remain unclear in the minds of many people (Schoenfeld & Baron, 1965). Although neither the definition of instinct nor the criteria for the dichotomy have been formally put forth, ethologists characterized instinctive behavior by several properties (Lorenz, 1956). The critics of ethological theory not only questioned the reality of the attributes of instinct but also considered it inappropriate to create a category for behavior, the underlying physiological basis for which is of a heterogeneous nature (Beach, 1955; Lehrman, 1953; Schneirla, 1956). Jensen (1961) argued that instinct is not demonstrable since it is not operationally defined. However, some of its important attributes are operationally defined, i.e. "operations necessary to demonstrate" them are possible. The present paper attempts at re-evaluating those attributes of instinct.

INHERITANCE OF BEHAVIOR

Introduction of genetical terms and concepts to the discussion of instinct and learning caused some semantic confusion. The inseparableness of heredity and environment in the production of the phenotype applies to morphological traits as well as to behavioral ones (Hebb, 1953). Traits, whether morphological or behavioral, can be defined only as differences between individuals or groups. When one speaks of a hereditary trait one means neither the transmission of the trait as such nor its complete independence from the environment, but it is a shorthand expression for the results of operations used to demonstrate that the trait is due to genetic differences rather than to environmental variation. In the above sense behavioral traits can be said to be inherited, instead of which other terms such as phylogenetically acquired (Lorenz, 1961, 1965), innate or instinct may be employed insofar as they are used in the same sense. However,
historically vaguely defined terms such as innate and instinct should be avoided in this context.

To conclude that certain traits are inherited requires breeding experiments. Species-specific motor or fixed action patterns offer unique opportunities for studying behavior genetics. Cross-breeding closely related species indicates that some species-specific motor patterns are monogenically inherited (Von Hörmann-Heck, 1957). More often, however, the inheritance of species-specific motor patterns seems to be polygenic (Clark, Aronson & Gordon, 1954; Hinde, 1956).

The methods of population genetics enable one to analyze the components of quantitative phenotypic variance of a population by the following relationship: \( \sigma_P^2 = \sigma_G^2 + \sigma_E^2 + \sigma_{GE}^2 \) where \( \sigma_P^2 \): phenotypic variance, \( \sigma_G^2 \): genotypic variance, \( \sigma_E^2 \): environmental variance and \( \sigma_{GE}^2 \): variance in interaction between genotype and environment (Broadhurst & Jinks, 1963; Falconer, 1961). Another line of evidence for the inheritance of behavioral traits comes from selective breeding (Manning, 1961). Recent literature on the genetics of species-specific behavior has been reviewed by Dilger (1962).

It is a common practice among comparative anatomists and systematists to work on the assumption that the major differences between animal groups are due to the genetic differences between them, although this is seldom mentioned explicitly. Comparative ethology is also based on the same assumption and has proven a useful tool in systematics (Baerends, 1958; Tinbergen, 1960). As mentioned above, some interspecific differences in behavior can be shown to be due to genetic differences between the species.

However, uncritical reliance by ethologists on the stereotypy of behavior as the criterion for its inheritance invites criticisms. For example, song dialects of the White-crowned Sparrow, which are highly stereotyped and group-specific, are transmitted from generation to generation by learning (Marler & Tamura, 1964).

CENTRAL CONTROL OF MOTOR COORDINATION

Analysis of coordinated movements led ethologists to the conclusion that such movements consists of fixed (Erbkoordination) and variable (Taxis) components. They claimed that the fixed component is centrally coordinated, whereas motor responses to peripheral sensory inputs constitute the taxic component (Lorenz & Tinbergen, 1938). Before going into more detail on this issue, it is necessary to define the term "coordination" as used here. Motor coordinations are defined as sequences of muscular contractions in time and space which produce biologically meaningful patterns of movement.