DE GRUYTER
MOUTON

Timo Maran, Dario Martinelli,
Aleksei Turovski (Eds.)

READINGS IN ZOOSEMIOTICS

SEMIOTICS, COMMUNICATION AND COGNITION

Readings in Zoosemiotics

Semiotics, Communication and Cognition 8

Editors

Paul Cobley
Kalevi Kull

De Gruyter Mouton

Readings in Zoosemiotics

Edited by

Timo Maran
Dario Martinelli
Aleksei Turovski

De Gruyter Mouton

ISBN 978-3-11-025320-7
e-ISBN 978-3-11-025343-6
ISSN 1867-0873

Library of Congress Cataloging-in-Publication Data

Readings in zoosemiotics / edited by Timo Maran, Dario Martinelli, Aleksei Turovski.
p. cm. − (Semiotics, communication and cognition ; 8)
Includes bibliographical references and index.
ISBN 978-3-11-025320-7 (hardcover : alk. paper)
ISBN 978-3-11-025342-9 (pbk. : alk. paper)
1. Animal communication. 2. Human-animal communication. 3. Biology − Semiotics. I. Maran, Timo, 1975− II. Martinelli, Dario. III. Turovski, Aleksei.
QL776.R43 2011
591.59−dc23
2011033586

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Cover design based on a design by Martin Zech, Bremen
Typesetting: PTP Berlin Protago TEX-Production GmbH, Berlin
Printing: Hubert & Co. GmbH & Co. KG, Göttingen
∞ Printed on acid-free paper

Printed in Germany

www.degruyter.com

Contents

Prehistory

Essentials in Zoosemiotics

Chapters from Animal Communication Studies

Theoretical and Metatheoretical Perspectives

Human(itie)s, Animals and Contemporary Zoosemiotics

Readings in Zoosemiotics

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

1. Introduction

Zoosemiotics is a field of inquiry introduced and developed by Thomas Albert Sebeok, starting from 1963, when the term and a first definition make their first appearance (Sebeok 1963: 465). In the light of its most recent developments, zoosemiotics can be defined today as *the study of signification, communication and representation within and across animal species*.

The implications of this definition are crucial. *First of all*, the focus of zoosemiotics is not simply communication, but rather starts from semiosis, i.e., following Charles Morris, the process in which something is a sign to some organism (Morris [1946] 1971: 366), and involves every single process of production, exchange and interpretation of signs. Communication, the process in which a sign is coded and transmitted from a sender to a receiver, is thus to be considered just one among many processes of this kind, albeit an important one.

To mention another important process, zoosemiotics is interested also in the phenomenon of signification, occurring when the receiver is the only subject involved, and a true sender is missing. In other words, zoosemiotics also studies the ways animals make sense of their environment and other animals. Also the relatedness of these two aspects—signification of animals and signification of environment needs to be emphasized as a type of context-dependence of semiotic processes.

Another vast and important sphere of study includes different representations as artefacts of communication. Representations can take part in signification and communication, but they have also their separate existence and can be thus studied with the help of methods more typical to semiotics of culture and other paradigms of humanities. Such artefacts include texts, names, depictions, beliefs, myths or factual knowledge about animals. This aspect of zoosemiotic research can also be called anthropological zoosemiotics (or, shortly, anthrozoosemiotics), i.e. the study of semiotic relations between humans and other animals.

Secondly, zoosemiotics studies both cases of intraspecific and interspecific semiotic relations. By intraspecific we mean sign action or interaction occurring within one single animal species, i.e., within a group of animals that supposedly share a fairly similar perception of the world and similar ways to codify it. By interspecific, on the other hand, we mean sign action or interaction occurring between different species, i.e., between groups that do not share a similar perception and codification of the world, except perhaps to a very basic degree (this normally being the very ground for establishing a—temporary or not—*common* code). In interspecific relations such as in various symbioses animals often do not rely on communication by use of a common code but, rather, try to make sense out of each-other by using what is called here a 'signification process'.

In this sphere the semiotic aspect of natural hybridization between closely related species could be a highly effective instrument in approaching evolutionary ethology e.g. in the case of many taxons of passerine and other birds on which vast materials have been published for example in E. N. Panov's *Natural Hybridization and Ethological Isolation in Birds* (Panov 1989). Also the applicability of zoosemiotic methods in the field of the ecology of behaviour e.g. in the problematics of the Gause theorem (the rate of competition between very closely related species in the same association, see Gause 1936) seems to be promising. Altogether, applying a zoosemiotic approach to the determinations of parallelisms and convergences in animal behaviour seems to be very tempting indeed.

Thirdly, the use of the term "animal species" is here intended to cover the entire Animal Kingdom, i.e., the human species as well. This means not only that part of human semiotic behaviour (namely, non-linguistic behaviour) easily falls into the zoosemiotic domain, as ethology has already shown, but also that zoosemiotics investigates a field of knowledge that includes both natural and cultural elements. This, however, does not mean inclination towards biological determinism, but rather acknowledging the complex intertwining of culture and biology in human–animal relations, in cultural inheritance among non-human animals and in other similar topics. In this field the zoosemiotic approach to the study of the ways and developments by which animal species got involved in myth as zoomorphous classificators could be extremely productive.

2. From Biosemiotics to Zoosemiotics

The discipline's history, theoretical paradigm, several methodological issues and the overall general feedback from the academic environment, are all topics that make zoosemiotics walk hand in hand with the broader field of biosemiotics, the discipline that studies semiosic processes occurring in all living forms.

If we exclude those fields of inquiry regarding the (mostly medical) observation of the body (symptomatology, diagnostics, etc.), carried out already by figures like Hippocrates or Galen of Pergamon, semiotics has been an anthropocentric and logocentric discipline throughout much of its history, that is, it has put the greatest emphasis on human- and human language-related issues. Things started to change during the second half of the 19th century together with the growth of interest in animal evolution, cognition and communication. At the end of the century the American philosopher and semiotician Charles S. Peirce gave the first philosophical acknowledgement of the semiotic nature of the non-human world (to him, sign was a connective element not only in all experience and thought, but in the whole universe), but it was not until the work of the Baltic-German biologist Jakob von Uexküll, that the first, important, specific argumentation in support of biosemiotics was provided. In 1926, at University of Hamburg, Uexküll founded the *Institut für Umweltforschung*, whose main purpose was the study of the perceptive environment of animals or their Umwelten (a concept that will be discussed at length, below). Later, Jakob von Uexküll's son Thure, and Thomas A. Sebeok underlined the intimately semiotic nature of Uexküll's work. In the 1970–1980's the Italian oncologist Giorgio Prodi came to denominate "nature semiotics" the study of biological codes.

However, the term "biosemiotics" was first actually used in a scientific context by Friedrich S. Rothschild (1962: 777). One year later, Sebeok announced the development of the theoretical paradigm of zoosemiotics, at the same time coining this new term and effectively inaugurating the modern phase of biosemiotic history. This event is certainly *the* milestone in zoosemiotic history, and shall be discussed more thoroughly later on.

But, considering for the moment the wider term, in 1971 the Russian semiotician Yuri Stepanov used the word "biosemiotics" extensively in his work (Stepanov 1971), and after Sebeok used it in international contexts in 1975 and 1986 it spread all over the semioticians' community. Today biosemiotics is the forefront of semiotic thought.

Biosemiotics is complex and in no way to be considered reductionist. However, some key tenets can be identified. According to Sebeok,

> The process of message exchanges, or *semiosis*, is an indispensable characteristic of all terrestrial life forms. It is this capacity for containing, replicating, and expressing messages, of extracting their signification, that, in fact, distinguishes them more from the nonliving—except for human agents, such as computers or robots, that can be programmed to simulate communication—than any other

> traits often cited. The study of the twin processes of communication and signification can be regarded as ultimately a branch of the life science, or as belonging in large part to nature, in some part to culture, which is, of course, also a part of nature. (Sebeok 1991: 22) The life science and the sign science thus mutually imply one another. (Sebeok 1994: 114)

This definition introduces some important key-terms and concepts:

1. The concept of semiosis, i.e., the action of signs, is the first and foremost object of semiotics.
2. All life forms are semiosic. Thus, semiosis is primarily what distinguishes life from non-life.
3. Culture and Nature are not concepts in opposition, but in fact the former is part of the latter.
4. If the life science intersects with the sign science, then semiosphere and biosphere are probably synonyms.

As animals are the most integrated living creatures in the Biosphere, similarly there is no such thing as a completely singular animal: all are living in associations. Besides all and any other circumstances involved, that means that one of the ruling traits of behaviour is the need for impressions: to make, to receive, to avoid and to use the impression is the semiotic basis of charismatic behaviour. In every animal association, there are several species of charismatic significance by which the other members of the association are oriented, as dominant sources of signs, to behave in certain situations (e.g. deliberate changes in elephant behaviour in the case of an approaching earthquake is a general trigger for uphill evacuation for the majority of mammal species in the biome). In rapidly changing ecological systems *Homo sapiens* nowadays is steadfastly becoming one of the main charismatic members of animal associations.

Over and above such impressions, Jesper Hoffmeyer has pointed out the centrality of semiosis in biological studies. To Hoffmeyer, the biggest contribution that biosemiotics can provide to life sciences is the recognition of sign and semiosis as the crucial elements in life: expansion of semiotic processes is the "most pronounced feature of organic evolution" (Hoffmeyer 1996: 61), and sign is the "basic unit for studying life" (Hoffmeyer 1995: 369). This is the intuition shared by biosemiotics and zoosemiotics. At the same time zoosemiotics is not biosemiotics: that is, there are also essential differences between the two paradigms. Contemporary biosemiotics seeks to develop mainly theoretical and philosophical approach towards semiotic processes in living systems or to study semiosis on the molecular or cellular level. The focus of zoosemiotics stays primarily on organismic levels and its interest lies in sign processes as they are interpreted by the living organism.

3. Understanding Communication

The first and foremost objection that can be (and has on several occasions been) made against disciplines like biosemiotics and zoosemiotics is: is it acceptable to study processes in non-human nature by using semiotic methods and theories that were initially developed in humanities? In answer, it is not a big problem to accept that there are cognition or communication processes taking place among animals, especially higher mammals such as dogs, dolphins or apes. After all, different paradigms in biology (cognitive ethology, behavioural ecology, etc.) study these processes in animals on a daily basis, including also more simple organisms, such as various groups of invertebrates. Thus, rather than the existence of communication among animals, the question is about how zoosemiotics approaches communication.

First, it should be noted that there are many possible ways to approach communication, and different paradigms use different ways according to their needs and the specifics of their subject matter (see Dance and Larson 1976). For zoosemiotics, at first glance it would seem a natural choice to use some definition employed in biological sciences. Unfortunately this would not do, as understanding of communication in biology is often deterministic or mechanical or both. As an example of this, behavioural ecologists John R. Krebs and Nicholas B. Davis define communication as “the process in which actors use specially designed signals or displays to modify the behaviour of reactors” (1993: 349). For the discipline of semiotics, which aims to emphasise semiosic and interpretative aspects of the communication, such definition is clearly unsuitable.

On the other hand, many approaches from the linguistic/semiological tradition (as opposed to semiotics—see Cobley 2009) do not satisfy the requirements of zoosemiotics either. This especially applies to the cases where intentionality is taken as a criterion of communication and only intentional or purposeful acts are considered worth semiotic analysis (e.g. Mackay 1975). In such case, for semiotics to be *interested* in a given message, that message must be somehow *meant*. For instance, it may be acceptable that a painting, a building, a sonata are considered ‘messages’ or ‘texts’, along with literary works, but photosynthesis, genetic transmission and ‘bee dances’ cannot, for they—at least apparently—do not meet the requirements of a communicative, intentional action.

This stance, however, presents several difficulties. First, the concept of intentionality itself as a philosophical concept is complex and not clearly defined at all. Second, to limit semiotics solely to the communicative/intentional dimension means to classify not only non-human sign actions as semiotically uninteresting, but most human ones as well, such as gestures, mimicry, body-language and proxemics. It also creates difficulties for studying non-direct instances of communication, for instance some artefact of ancient culture having communicative value and meaning for us. Third, introducing intentionality into communication tends to create a distinction between its levels of organisation. Intentionality is generally considered as a feature of a single individual, act or process. By using intentionality as a criterion of communication we risk excluding social, cultural and also evolutionary aspects of communication. Fourth, and more specific to zoosemiotics, intentionality of human communication can sometimes be determined by verbal means—just asking a person, does s/he mean, what s/he is doing or saying. There is no such possibility regarding other animals, but the inability to communicate one's intention should not say anything about the existence of intentions themselves.

The zoosemiotic approach should apparently develop its own wider understanding of communication that would meet requirements imposed also by bodily postures, communication with time-lag, interspecific relations, and evolutionary fixed displays. A broad intuition, expressed by Thomas A. Sebeok—"communication can be regarded as the transmission of any influence from one part of a living system to another part, thus producing change" (Sebeok 1991: 22)—could be a good starting point. This statement should, obviously, be interpreted in the wider context of Sebeokian thinking. Sebeok specifies that it is a 'message' that is being transmitted. Also, the message in the process of communication can be further scrutinized according to its three main aspects: syntactics, semantics and pragmatics. Zoopragmatics deals with the origin, propagation and effects of signs. Zoosyntactics targets the combination of signs: such questions as message composition, code, and repertoire of messages available for particular species. Zoosemantics is concerned with the meaning and context of messages (Sebeok 1972: 124–132). Using three dimensions of semiosis, introduced originally by Charles Morris, to organise the communication process in living system also hints that it is foremost the process of semiosis that is the focus of zoosemiotic studies. In zoosemiotics, communication is approached from the viewpoint of semiosic, interpretational activity and not vice versa.

4. Positioning Zoosemiotics

Life semiosis, in general, can take place either *within* a living being and/or *between* two or more such beings. The discipline studying the former is named endosemiotics, or—according to the specific cases—protosemiotics, microsemiotics, cytosemiotics, etc. Endosemiotics focuses on message exchange among cellular organelles, cells, tissues, organs and organ systems. Exosemiotics, the latter case of life semiosis, regards the entire spectrum of message exchange between two or more complex organisms. Fields of exosemiotics can be divided into *phytosemiotics* (whose object is the sign action among plants), *mycosemiotics* (sign action among fungi) and finally *zoosemiotics* (sign action among animals). A specific branch of zoosemiotics is obviously *anthroposemiotics*, i.e., semiosis among human animals. Such typology is largely based on the works of Sebeok and in broad terms follows the main divisions or *Regna Naturae*, described already by Aristotle and Linnaeus. It is, however, also semiotically reasonable, as plants, fungi and animals have different body organisations and therefore different capabilities for semiotic activity. The position of anthroposemiotics, distinguished by some scholars, remains ambiguous here. On the one hand, lining anthroposemiotics alongside the three types previously mentioned (this positioning can be based on a claim that the distinctive feature of anthroposemiotics is the presence of culture) is incorrect, both scientifically (the human being *is* an animal, not a distinct entity) and conceptually (the notion of culture, unless meant very narrowly[1], is not alien to other animals as well). On the other hand, this should not mean denying or questioning the special scope of interest and methodologies of cultural semiotics, semiotics of literature etc. that focus on specific types of sign activities that are characteristic of human species.

Sebeok's very introduction of zoosemiotics into the scientific world was obviously far from being the first attempt to study non-human signalling behaviour: leaving aside a series of proto-semiotic philosophical reflections, as those provided by Porphyry, John Locke or David Hume (some of which are included in this volume), it was the impact of Charles Darwin on animal studies, and particularly two of his late works, *The Descent of Man, and Selection in Relation to Sex* (1871), and *The Expression of Emotions in Man and Animals* (1872) that radically changed the scientific perception and conceptualisation of animal communication. Also, works of some of his followers, like George Romanes, can be considered relevant to zoosemiotics. Sebeok opened a door that other scholars were rather hesitant to even touch. When one compares pre- or non-semiotic definitions of animal communication, such as those of John R. Krebs and Nicholas B. Davis (given above) or Edward O. Wilson ("communication [is] action on the part of one organism (or cell) that alters the probability patern of behavior in another organism (or cell) in an adaptive fashion" 1975: 10), with those provided by Sebeok ("the discipline, within which the science of signs intersects with ethology, devoted to the scientific study of signalling behavior in and across animal species." (Sebeok 1963: 465); "The

---

[1] And therefore, once again, excluding the majority of human communities too.

basic assumption of zoosemiotics is that, in the last analysis, all animals are social beings, each species with a characteristic set of communication problems to solve" Sebeok 1972: 130) and by other semioticians, it is clear how, with the support of a semiotic approach, animal sign action could finally get rid of the rigid stimulus-reaction scheme and achieve a much more 'significant' status.

From that point on, zoosemiotics has enjoyed an increasing popularity among scholars (although, perhaps, not enough to confer it the status of an autonomous field within semiotics, as it will be later discussed). The wide range of topics covered by zoosemiotics, plus its intrinsically interdisciplinary nature, have made this field a rather eclectic one, with incursions into several fields of semiotics, including some apparently-strictly anthropological ones.

Following the classification of the approaches of scholars in zoosemiotics suggested in Martinelli (2007: 32–34), there can be distinguished at least two main branches within zoosemiotics, both to be divided, in turn, into more sub-branches. On the one hand, there is zoosemiotics in the traditional sense, i.e., a discipline dealing with animal sign action, through the most obvious theoretical tools of semiotics. This branch is named *ethological zoosemiotics*. Ethological zoosemiotics can again be divided into a *traditional current* and a *cognitive* one. The former includes studies performed by the early Sebeok, or Martin Lindauer, or other scholars belonging to the Lorenzian school or the behaviouristic traditions. The cognitive current features the later Sebeok, W. John Smith, Dominique Lestel and several others, including editors of this volume, and starts from the assumption that the bases of animal semiotic phenomena are also of a mental type.

The second branch of zoosemiotics, called *anthropological*, refers to studies dealing with the semiotic interaction between human beings and other animals, including those of cultural and/or sociological type. This branch was projected, although not systematically defined, by Sebeok and by the zoologist Heini Hediger. Interspecific communication experiments are one example of anthrozoosemiotics (although very sceptical, Sebeok dealt quite often with those, and so, also, have Susan Petrilli, John Deely, Felice Cimatti, Marc Bekoff and others). These types of study fall under a sub-category of anthropological zoosemiotics named *communicational*. In those contexts, in other words, the human-animal interaction is of a communicative type, i.e., interactive, reciprocal and—with the above-mentioned reservations—intentional. Studies of applied zoosemiotics, such as human–pets or human–cattle interaction, fall under this group as well.

The second sub-category within anthropological zoosemiotics is named *representational*: here, the non-human animal is a pure source of meaning, an object, rather than a subject, of representation. The model is of an 'ecosemiotic' type: whereas, indeed, ecosemiotics is the study of human representation of nature in general (to follow the interpretation of Kull 1998), this type of zoosemiotics deals with the human representation of other animals. This is evidently the case of cultural representations, language strategies, myths, tales, allegories, but also and/or encyclopaedic systematic classifications, such as taxonomy and other forms of terminology.

A third sub-category may be called purely *comparative*, and refers to the mere comparison between human semiosis and various non-human ones, including studies on the (often phylogenetic) continuity between one or more species and the human one. From the previous categorisation it appears that ethological zoosemiotics has a close relationship with natural sciences (starting, obviously, from ethology), while anthropological zoosemiotics is a closer relative of the human sciences, especially so-called anthrozoology and the social sciences, which nowadays demonstrate an increasing interest in animal-related issues (Tim Ingold being one very relevant author). It is thus rather safe to say that zoosemiotics 1) is interdisciplinary, and 2) occupies an intermediary position between the natural and human sciences.

There are also other possibilities to organise the field of zoosemiotics. As mentioned in the beginning of this introduction, based on the object of study and corresponding methodology, zoosemiotics can be divided between a significational, communicational and representational type. Based on its applicability, Thomas A. Sebeok suggested the distinction between pure, descriptive and applied zoosemiotics (Sebeok 1972: 132). According to his views, pure zoosemiotics should be concerned with the development of language and models designed to deal scientifically with signs in animals; descriptive zoosemiotics should study the pragmatic, semantic, and syntactic aspect of animal communication; and applied zoosemiotics should study the possibilities to use and manipulate the semiotic activity of animals for practical goals, for instance veterinary methods of ethological diagnostics (e.g. Turovski 2002) are actually based on close scrutiny of the signs of the state of health and fitness in animal behaviour.

5. The Importance of the Umwelt Theory

In the attempt to understand what is the most suitable general methodological framework for a discipline like zoosemiotics (in other words, how a human researcher should theoretically approach other animal species), it turns out that many possible solutions have several points in common, which ultimately lead to three main categories of approach: *gradualism*, *discontinuity* and *pluralism*.

By *gradualism* we mean a generically Darwinian approach (although the scalar imagination of nature is definitely much older). The idea is that of an evolutionary continuum in which the human being occupies the highest position, and in which, position after position, the characteristics of the diverse animal, fungi and plant species are less and less complex and refined, although adequate for ensuring the survival of the species in question. For instance, language is, in this framework, considered a unique and gradual structure which finds its maximum development in human beings. This means that signs and signals emitted by other animals may easily be considered "language", but the apparently lower complexity of those signs and signals of animals languages, the lack of elements present in the human language and other such differences are considered as manifestations of a comparatively inferior development. A semiotic example of such an approach is Charles Hockett's list of features that characterize human language. Many of those are also present in other species, but all 13 (16 in a later version) together are supposed to be present only in human language (Hockett 1960). Typical gradualistic attitudes are also recognisable in those who consider birdsong as proto-musical, and who more generally maintain that the origins and rudiments of art can be traced to several animal species. For instance, Marler and Hamilton take a gradualistic approach when they declare: "we must also bear in mind the possibility that some aspects of song variation [in birds] are a manifestation of some kind of primordial exercise in aesthetics" (Marler and Hamilton 1966: 446).

Discontinuity refers to an attitude that is generally sceptical of, if not hostile towards, the hypothesis that other living species can be compared to humans on a qualitative basis. The typical approach here is to emphasise indeed a "discontinuity" in the evolution of human beings, in comparison with all other animals. In other words, a sort of autonomous and peculiar development started at some point in the human evolutionary course, such that every behavioural element articulated from then on constituted an exclusively human characteristic. An example of discontinuity is the opinion that language is a typically human phenomenon which is categorically different from all signs and signals emitted by other animals. Such an approach is most often related to Chomskyan linguistics, but the shadow of it can also be found in some apparently biosemiotic studies (e.g. Deacon 1997).

The *pluralistic* approach (based on the concept of Umwelt) proceeds from the assumption that the environment where an organism lives does not only consist of an actual environmental niche, but that the latter is merely a physical portion of a bigger, not purely physical 'environment' (Umwelt, in effect), which is perceivable and meaningful in its entirety only from the perspective of that particular organism.

For instance, when a human being deals with a piece of furniture consisting of a smooth flat wooden slab fixed on legs, s/he most probably will call such an entity "a table". The very same piece of matter, to another organism such as a wood-worm (for instance larvae of longhorn beetles *Cerambycidae*), appears clearly as something else (in this case an extensive food area). The human subject and the wood-worm are looking at the same entity, apparently sharing the same environment, they are in the same area of the planet Earth and are surrounded by the same quantity and quality of matter and molecules. Nevertheless, the human being and the wood-worm do not share the same Umwelt, i.e., the same subjective/perceptive environment. The wood-worm, because of its physical constitution, its modes of perception, its experience, and in relation to what is *necessary* and *interesting* to its existence, interprets the surrounding environment in a totally different way than humans do. The human, in turn, has a given physical constitution, given perceptual possibilities, etc. In other words, although living in the same environment, human beings and wood-worms establish a different relation with the table (a relation that is obviously semiotic). Humans and wood-worms see the same things as different objects, and therefore live in different Umwelten.

Concerning communication, Umwelt theory would also aim towards a pluralistic approach. According to this view, communication systems should not be viewed as forming a hierarchy, but rather their specific peculiarities should be emphasized and investigated. Studies of the various animal species' communicative abilities that remain outside the human Umwelt—ultraviolet markings, pheromones, tactile perception—serve here as a good example. Also, in the studies of birdsong complexity on the syntactic level has been noted (compared to the semantic complexity of human language). Conveying the same meaning by various different syllables cannot be interpreted, however, as something less than human language, but also as something extra—emphasising for instance the aesthetic dimension in avian communication.

The most significant zoosemiotic implications of Umwelt theory are three:

1. In order to understand non-human animal semiosis, one first needs to investigate how a given animal/species organises its own experience, i.e., what is pertinent to it and what is not.
2. Something interesting or pertinent for a representative of a given species may not be perceived by a representative of another species at all. This is often the case for instance in mimicry resemblances (Maran 2007).
3. What looks/sounds/appears like an incoherent/incomprehensible/illogical behavioural pattern in a given species, depends in reality on the fact that the animal in question experiences the same situation according to different perceptual criteria than a human being (or another species).

Rather erroneously, the term Umwelt has frequently been confused with that of “environmental niche”, or in other cases with “habitat”, and in the most inattentive cases, with “environment” (based on its original meaning in German). It is evident, though, that Umwelt does not designate a touchable and tangible category, but rather an array of subjective and perceptive elements.

More specifically, Uexküll considers Umwelt to be the result of two main elements: the *Merkwelt*, i.e., the specific perceptive field of a given organism, and the *Wirkwelt*, i.e., the field of actual interaction, the operational dimension of the same organism. Perceptual and operational factors contribute to form a specific Umwelt, which is exclusive for each species, and—proceeding by levels, and establishing adequate proportions—for each individual, population, family, class and so forth. To conceive animals in the light of Umwelt theory means at the same time to acknowledge common biological and evolutionary bases as well as species-specific traits and specific ontogenetic developments. It means, in other words, to take into account the biological foundations of certain behavioural patterns, and the autonomous and peculiar developments of others.

Although more similar to gradualism than to discontinuity, Umwelt theory is undoubtedly a third way for zoosemiotics. Semiosis, and all that follows from it, cannot be conceived as a single continuum, simply divided by grades. To locate a given element on one level instead of another, implies an understanding of where exactly that element should be considered pertinent (e.g., once again, is symbolic use of communication a feature characteristic of human beings exclusively? Or does it pertain also to great apes? Or primates in general? Or mammals? Or animals? Or living beings?) and also where (i.e., at which point) certain traits can be analysed in their specific autonomy.

Semiosis is the result of interaction between a subject and an object, between a structure and a counter-structure, between a receptor and a carrier of meaning. These two parts are in constant and reciprocal informational exchange. In fact, the exchange itself is the real generator of any semiotic phenomenon, since the latter would simply not exist if the subject was not affected by it and did not affect it. Any zoosemiotic research, from pheromones to whale songs, should take into account such a conception, otherwise it risks perverting the essence of semiotic phenomena themselves.

6. Zoosemiotics Today

Although to be considered a relevant field within the entire semiotic panorama, the importance of zoosemiotics as a discipline, or even as a simple idea, has not always been met with great enthusiasm among semioticians and other scholars.

In this sense, the dissemination of zoosemiotics has had limits, even though there are positive examples of other novel semiotic paradigms, for instance, musical semiotics or biosemiotics itself, two examples of semiotic branches in which regular publications are issued and several international congresses are arranged. The publication of an explicitly zoosemiotic text is a much rarer event, and it was only 2011 when the first international conference in zoosemiotics was organised in Tartu, Estonia.

Moreover, if it is not very difficult to encounter comments or topics of zoosemiotic concern, it is, however, rare to encounter self-styled zoosemioticians: rather, they might either belong to different disciplines dealing with the same issues (quite often ethology, as the case of Marc Bekoff illustrates), or deal with zoosemiotic issues only in exceptional cases, their specialisation (and academic identity) being of different type (the case of semioticians John Deely or Susan Petrilli). It is significant that Winfried Nöth, in writing the chapter of zoosemiotics which appeared twenty years ago in *Handbook of Semiotics*, ends up referring quite exclusively to scholars belonging to other disciplines (Nöth 1990: 145–167). Exceptions are evidently Sebeok, and—to a fair extent—W. John Smith and Günter Tembrock (both are ethologists with theoretical interests, but extremely semiotic in their contents). Beside those scholars, the zoosemiotic paradigm has been influenced significantly by the works of Felice Cimatti (a quite peculiar case, as he moved from a convincing cognitive position, in the excellent *Mente e linguaggio negli animali. Introduzione alla zoosemiotica cognitive* (1998), to a traditional, or even pre-traditional one, with strong Cartesian influences, in the next *La mente silenziosa. Come pensano gli animali non umani* (2002)—unfortunately, neither of these works have been translated into English); Heini Hediger (an important promoter of the biology of zoos, whose work—especially in the important *Man and Animal in the Zoo: Zoo Biology* (1969)—has been of deep zoosemiotic concern, appreciated much by Thomas A. Sebeok); and Peter Marler (researcher of animal communication with recurrent and explicit semiotic concerns). From more recent history the studies of Dominique Lestel (with a very wide range of concern that includes ethological studies in cognition, culture and art); John Deely (whom one may call a part-time zoosemiotician, his main interests lying in semiotic history and philosophy—a major follower of the Sebeokian tradition, who has systematised several of his zoosemiotic reflections, and made extensive contributions to the dissemination of Umwelt-theory) and Marc Bekoff (primarily an ethologist, but profoundly interested in zoosemiotic issues, and author of the journal *Semiotica*) can be seen as highly relevant. Then—of course—one should mention the crypto-zoosemioticians, Charles Darwin and Jakob von Uexküll. However, to give an overview of the whole list of crypto-, pseudo-, proto- or parazoosemioticians (which would then include fundamental scholars like Desmond Morris, Karl von Frisch, Donald Griffin, Nikolaas Tinbergen, biosemioticians and representatives of other paradigms of semiotics, who feel sympathy towards zoosemiotics and occasionally join the debate (Susan Petrilli, Kalevi Kull, Paul Cobley, Frederik Stjernfelt, etc), plus various experimental interspecific communication scholars, like Roger Fouts, Francine Patterson etc.) would be a task too extensive for this small survey. Still, if we were to briefly characterise this list of scholars, their methodological motivation should be mentioned: for some, this paradigm seems to be the natural continuation of what is happening already in other animal-related studies (ethology being the most relevant case); for others, the reason is intrinsically semiotic, and partly relates to the current prevalence that Peircean semiotics has achieved over the structuralist tradition. The synthesis of those different approaches into an integrated zoosemiotic treatment needs yet to be elaborated.

For the developing field compiling such a list of authors can be result in nothing comprehensive, and also this survey has left out many scholars that are relevant and often cited in zoosemiotic articles. More than focusing on specific authors, an overview of current trends and research issues can give an insight into contemporary zoosemiotics. To start with, zoosemiotics, along with other semiotic fields, is acquiring more and more an ethically-minded approach. When one thinks of the establishment and the rapid spreading of such theoretical projects as Semioethics (proposed by the scholars of University of Bari) or Existential Semiotics (proposed by Eero Tarasti), it becomes clear that semiotics has probably emancipated itself from the role of a purely descriptive field of inquiry, and it aims at becoming a relevant prescriptive paradigm. Zoosemiotics, for instance through the works of Bekoff, Lestel, Martinelli, Turovski and others, seems to be willing to follow a similar route.

Secondly, what has been called here a cognitive approach, i.e., the anti-mechanistic and anti-behaviouristic paradigm, is enjoying increasing consensus among zoosemioticians. Excluding the somehow unexpected turn by Felice Cimatti, all the others mentioned seem to agree on the subjectivity and existence of mental life in animal species (each with their own sources and species-specific limitations), that underlies any semiotic action, from the most complex to the simplest one. The zoosemiotic approach could possibly enhance studies of animal's emotionality, considering emotion as a mechanism of mobilizing and channelling activity in animal behaviour, and perhaps even studies on animal thinking and memory if we could define these as holistic behavioural reactivity based on episodic and situational experience. This goes hand in hand with the questioning of human uniqueness in possessing specific features such as culture, aesthetics, symbolic signalling, and—most of all—language. In some cases, aesthetics especially, there seem to be no more doubts, among semioticians, that categories of this type can be justly—if not easily—applied to the semiotic behaviour of other animal species. In some others, language primarily, the question remains open, and the discussion sharp.

Thirdly, contemporary zoosemioticians are trying to explore different paths from the ones proposed by Sebeok, whose shadow is sometimes so big that one could be tempted to identify zoosemiotics exclusively with its founder. Although nobody would deny the unavoidable importance that the Hungarian-born scholar holds in this field, a few cases exist where scholars are either following other approaches, or even daring to question some of his assumptions. Here it is relevant to emphasise that the original training of Thomas A. Sebeok was in linguistics and his approach to zoosemiotics also bears this mark. Especially in his early works the transmissional models of communication (in the tradition of Shannon and Weaver or Bühler–Jakobson) has a central role. Such a theoretical platform can be useful for describing forms of communication where participants share the same sign system, code and Umwelt, whereas interspecific communication for instance in symbiotic relations seem to require a principally different approach. Also the close interrelations and interplays between physical, bodily and ecological aspects on the one hand and semiotic and communicational on the other seem to have become a central theme in post-Sebeokian zoosemiotics.

Fourth, an emphasis on holism or complementarity is a tendency that seems to be growing in contemporary zoosemiotics and that can be considered as one of its characteristics, distinguishing it from other similar approaches in natural sciences and humanities. Holism is understood here not as a philosophical platform or inclination towards some esoteric thinking, but rather as an epistemological standpoint—that is, to become aware of and to include in the study many different aspects of description from facts and observations of natural science to the depiction of animals in culture, from the history of research of animal communication to explicating one's own viewpoint and methodological sources as a researcher.

In conclusion, one may safely say that the big challenge for zoosemiotics, in its near future is the search for an affirmation of its own identity. It is certainly a discipline with a robust theoretical (methodological in particular) apparatus, but with too few followers convinced that following this path is any more worthwhile than the ones proposed by such disciplines as ethology or zoology. In particular, the apparent ease with which zoosemiotics is identified as just a special case of biosemiotics is rather tricky. On the one hand, it is true that zoosemiotics has historical and methodological relations with biosemiotics. Being part of a larger community increases the chances of exposure, and by improving the whole biosemiotic project it creates a condition from which zoosemiotics itself fully benefits. On the other hand, however, in doing so, zoosemioticians encourage a strongly anthropocentric slant within semiotics that they (as well as all other biosemioticians) should instead reject, i.e., they thus support the implication that all of the nature-related fields should be concentrated in one (no matter how big) single pot, while all cultural areas of semiotics have a right to enjoy a space of their own. For instance, when one thinks that a single human body consists of about 50 trillion cells, a number which is 7000 times bigger than the entire human population on this planet (plus, these cells have direct or indirect connections with each other through more than one modality), it becomes clear that an area like cytosemiotics is at least as entitled as literary semiotics to claim an exclusive territory for itself.

If biosemiotics, social semiotics, musical semiotics, and several others have been able to convince a fair number of biologists, sociologists and musicologists that the semiotic approach does actually add something to their own study, then ethologists, zoologists, sociobiologists and behavioural ecologists have so far found nothing so distinctively different or charming in zoosemiotics, except for the above-mentioned few cases. The question is, have these scholars ever had a chance to find it out? In other words, how often have zoosemioticians been able to expose zoosemiotics to colleagues from other fields? How often have the continuity between zoosemiotics and other fields been shown? How systematically has zoosemiotics been generally portrayed? The answer is that these occasions have been very few, and, of those few, most of them have not really been of any help, as they have ended up in strong polemics (the most famous instance being Sebeok's harsh rejection of interspecific communication scholars). As an encouraging sign of a brighter future for zoosemiotics, regular courses in zoosemiotics have lately emerged into curricula of several universities. All editors of this reader teach zoosemiotics on a regular basis (respectively Timo Maran at the University of Tartu, Dario Martinelli at the University of Helsinki, and Aleksei Turovski at Tallinn University). This book attempts to provide more convincing and humble answers to the above questions, and it tackles them by presenting first-hand material from the people who have shaped the implications, the idea, the paradigm and the research paths of zoosemiotics.

7. About This Book

The present reader covers a selection of materials, from texts with high historical value to contemporary zoosemiotic contributions, from influential case-studies in animal communication to theoretical elaborations. The selection of essays is based on the perception of contemporary zoosemiotics both from the inside (texts that have been discussed in publications by scholars identifying themselves as zoosemioticians and those that have been included in zoosemiotic lecture courses) as well as from the outside (zoosemiotics as perceived in introductions and encyclopaedias of general semiotics).

Texts are selected with two main aims kept in mind. First, to introduce zoosemiotics as a diverse field with a rich history, different authors and various research goals. This also means that the selection of texts is not limited to zoosemiotics in the strict sense, but also relevant articles from other nearby fields dealing with animal communication are included. The second aim is to make zoosemiotics approachable for readers with different scholarly backgrounds. This means seeking balance between papers with natural science, humanitarian and semiotic flavour and, in the role of editors, also treating controversial topics from a neutral and informative viewpoint. It is indeed a small niche between anthropomorphising animal communication on the one side and denying any subjectivity to animals on the other, but with the right focus, in between, a rich and interesting field of research will open.

The book is divided into five general sections: prehistory; essentials in zoosemiotics; chapters on animal communication studies; theoretical and metatheoretical perspectives; human(itie)s, animals and contemporary zoosemiotics. Each section is supplemented with a short introductory essay where the specific issues of this topic and the texts included in the reader are discussed. In addition, each essay briefly discusses some other texts that are also relevant but have been excluded from the reader due to the size limits.

The editors would like to thank Kalevi Kull, Paul Cobley, Elin Sütiste, Lina Navickaitė-Martinelli and students of zoosemiotics lecture courses for their help in editing this reader. Timo Maran's research concerning this reader has been supported by Estonian Science Foundation Grant No 7790 and by the European Union through the European Regional Development Fund (Center of Excellence CECT). The editors also express their gratitude to the respective copyright holders for the reprint permissions: Cambridge University Press (Bekoff, M., Allen, C. 1998. Intentional communication and social play: How and why animals negotiate and agree to play. In: Bekoff, M., Byers, J. A. (eds.). *Animal Play: Evolutionary, Comparative, and Ecological Perspectives*, 97–114. Cambridge: Cambridge University Press), Dover Publications (Hediger, H. 1968. The animal's expression. In: *The Psychology and Behaviour of Animals in Zoos and Circuses*, 141–153. New York: Dover Publications), Elsevier (Marler, P. 1961. The logical analysis of animal communication. *Journal of Theoretical Biology* 1, 295–317), Nobel Media (von Frisch, K. 1992. Decod-

ing the language of the bee. In: Lindsten J. (eds.). *Nobel Lectures, Physiology or Medicine 1971–1980*, 76–88. Singapore: World Scientific Publishing), Rockefeller University Press (Griffin, D. R. 1981. Is man language. In: *The Question of Animal Awareness: Evolutionary Continuity of Mental Experience*, 73–85. New York: Rockefeller University Press), Rodopi (Kull, K., Torop, P. 2003. Biotranslation: Translation between umwelten. In: Petrilli, S. (ed.). *Translation Translation*, 313–328. Amsterdam: Rodopi), Sage (Lestel, D. 2002. The biosemiotics and phylogenesis of culture. *Social Science Information* 41(1): 35–68), Taylor&Francis (Ingold, T. 1988. The animal in the study of humanity? In: Ingold, T. (ed.). *What is an Animal?* 84–99. London, Boston: Unwin Hyman; Seyfarth, R. M., Cheney, D. L. 1993. Meaning, reference and intentionality in the natural vocalizations of monkeys. In: Roitblat, H. L., Herman, L. M., Nachtigall, P. E. (eds.). *Language and Communication: Comparative Perspectives*, 195–219. Hillsdale, N.J: Lawrence Erlbaum Associates; Smith, W. J. 1991. Animal communication and the study of cognition. In: Ristau, C. A.; Donald R. Griffin (eds.). *Cognitive Ethology: The Minds of Animals: Essays in Honor of Donald R. Griffin*, 209–230. Hillsdale, N.J: L. Erlbaum Associates), University of California Press (Bateson, Gregory 1966. Problems in Cetacean and other mammalian communication. In: Norris, K. S. (ed.) Whales, Dolphins, and Porpoises. California: University of California Press, 569-578), Toronto Semiotic Circle (Sebeok, T. A. 1990. Zoosemiotics: At the intersection of nature and culture. In: *Essays in Zoosemiotics*, 37–47. Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto; Sebeok, T. A. 1990. 'Talking' with animals: Zoosemiotics explained. In: *Essays in Zoosemiotics*, 105–113. Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto). All effort has been made to find the rights holder of extracts republished in this book but in some cases they could not be found. We should be pleased if any publisher holding the relevant rights for extracts in question contact De Gruyter Mouton and we will give due acknowledgments in subsequent editions of this book.

Timo Maran, Dario Martinelli, Aleksei Turovski

References

Cobley, Paul
2009 Introduction. In: Paul Cobley (ed.), *The Routledge Companion to Semiotics*, 3–12. London: Routledge.

Cimatti, Felice
1998 *Mente e linguaggio negli animali. Introduzione alla zoosemiotica cognitive* (Mind and language in animals. Introduction to cognitive zoosemiotics). Roma: Carocci.

Cimatti, Felice
2002 *La mente silenziosa. Come pensano gli animali non umani* (The silent mind. How to think about non-human animals). Roma: Futura.

Dance, Frank E. X. and Carl E. Larson
1976 *The Functions of Human Communication. A Theoretical Approach*. New York: Holt, Rinehart and Winston.

Darwin, Charles
1871 *The Descent of Man and Selection in Relation to Sex*. London: Murray.

Darwin, Charles
1872 *The Expression of Emotions in Man and Animals*. London: Murray.

Deacon, Terrence W.
1997 *The Symbolic Species: The Co-evolution of Language and the Brain*. New York: W.W. Norton.

Gause, G. F.
1936 The principles of biocenology. *Quarterly Review of Biology* 11, 320–336.

Marler, Peter and William J. Hamilton III
1966 *Mechanisms of Animal Behaviour*. New York: Wiley & Sons.

Hediger, Heini
1969 *Man and Animal in the Zoo: Zoo Biology*. Transl. Gwynne Vevers and Winwood Reade. New York: Delacorte Press.

Hockett, Charles F.
1960 Logical considerations in the study of animal communication. In: Wesley E. Lanyon and William N. Tavolga (eds.), *Animal Sounds and Communication*, 392–430. Washington: American Institute of Biological Sciences.

Hoffmeyer, Jesper
1995 The semiotic body-mind. In: Norma Tasca (ed.), *Essays in Honor of Thomas A. Sebeok. A Special Issue of Cruzeiro Semiotico Revista Semestral*, 367–383. Porto: Almeida.

Hoffmeyer, Jesper
1996 *Signs of Meaning in the Universe*. Bloomington: Indiana University Press.

Krebs, John R. and Nicholas B. Davies
1993 *Introduction to Behavioural Ecology*. Oxford: Blackwell Science.

Kull, Kalevi
1998 Semiotic ecology: different natures in the semiosphere. *Sign Systems Studies* 26: 344–371.

Mackay, D. M.
1975 Formal analysis of communicative process. In: Robert A. Hinde (ed.), *Non-Verbal Communication*, 3–25. Cambridge: Cambridge University Press.

Maran, Timo
2007 Semiotic interpretations of biological mimicry. *Semiotica* 167(1/4), 223–248.

Martinelli, Dario
2007 *Zoosemiotics: Proposals for a Handbook.* (Acta Semiotica Fennica 26). Helsinki: International Semiotics Institute.

Morris, Charles W.
1971 [1946] Signs, language and behavior. In: Charles W. Morris, *Writings on the General Theory of Signs*. (Approaches to Semiotics 16), 73–397. The Hague: Mouton.

Nöth, Winfried
1990 *Handbook of Semiotics*. Bloomington: Indiana University Press.

Panov (Панов, Евгений Николаевич)
1989 *Гибридизация и этологическая изоляция у птиц* (Natural Hybridization and Ethological Isolation in Birds). Москва: Наука.

Rothschild, Friedrich Salomon
1962 Laws of symbolic mediation in the dynamics of self and personality. *Annals of New York Academy of Sciences* 96: 774–784.

Sebeok, Thomas A.
1963 Review. *Language* 39: 448–466.

Sebeok, Thomas A.
1972 Semiotics and ethology. In: Thomas A. Sebeok, *Perspectives in Zoosemiotics.* (Janua Linguarum. Series Minor 122), 122–161. The Hague: Mouton.

Sebeok, Thomas A.
1991 Communication. In: Thomas A. Sebeok, *A Sign is Just a Sign*, 22–35. Bloomington: Indiana University Press.

Sebeok, Thomas A.
1994 *Signs: An Introduction to Semiotics*. Toronto: University of Toronto Press.

Stepanov (Степанов, Юрий Сергеевич)
1971 Семиотика (*Semiotics*). Москва: Наука.

Turovski, Aleksei
2002 On the zoosemiotics of health and disease. *Sign Systems Studies* 30.1, 213–219.

Wilson, Edward O.
1975 *Sociobiology: The New Synthesis*. Cambridge, MA: Harvard University Press.

Prehistory

Introduction

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

Zoosemiotics is obviously older than zoosemiotics. As basically any other field of inquiry, the establishment and the institutionalisation of a discipline is a step that marks its maturity and certainly not its birth, a specific identification of the latter always being a demanding, if not hopeless, task. Animal perception, cognition, communication, feelings, experience, and other issues of semiotic interest (with the possible inclusion of morality and ethics) have been a constant concern for the majority of philosophers in human thought. Drawing a history of these speculations and/or empirical findings is extremely hard, as hard as presenting in this book a narrow selection of only three authors (with a further painful reduction of their writings to a few pages).

There are many ways to attempt a unified interpretation of this history (provided this is aimed at). One way, that somehow reflects the status of the current discussion in zoosemiotics, lies exactly in the tension between speculative and empirical research: more often than not (Descartes being the prototypical, and stereotypical, example), the latter has often been methodologically constructed as a consequence of the former, and in general any remark on animal actions and minds lies in the field of tension between the two approaches.

The possession of and the ability to use reason is a good example in this discussion, as well as possibly in the whole philosophical debate about non-human animals (together with feelings and ethics). In Aristotle's *Metaphysics*, "human" is defined as "the rational animal", and the possibility that other species are limited to very primitive forms of cognition is laid out (at the same time, his *Historia Animalium* marks the beginning of observations in animal behaviour and communication). In a similar vein, Thomas Aquinas (in the *Summa Theologica*, 1265–1274) observes that the lack of rationality in animals is causally connected to the lack of freedom. René Descartes (*Discourse on the Method of Rightly Conducting One's Reason and of Seeking Truth in the Sciences*, 1637) famously maintains that animals can be compared to machines without a soul, and he adds that an indicator of the existence of a mind is the presence of language. John Locke (*An Essay Concerning Human Understanding*, 1690) disagreed with Descartes in regard to perception, memory and basic reasoning, but maintained that animals are unable to think in abstract and general terms. Immanuel Kant (*Lectures on Ethics*, 1775–1780) added that such an inability implies lack of self-reflection, and it is exactly this point that allows human beings to treat other animals as mere instrumental values.

In a parallel current of thought we have philosophers who dissent with these views and instead offer an image of animal cognition as something only different—if at all different—with humans' in terms of degrees. Porphyry (*On Abstinence from Animal Food*) is mainly committed to ethical issues, but, in his advocacy for vegetarianism, he states clearly that one of the reasons to renounce animal killing is animals' ability to think and communicate. Differently from the Stoics and Peripatetics, Porphyry maintains that we can find the *logos*, discourse, among non-human animals ("each of them [animals] knows whether it is imbecile or strong, and, in consequence of this, it defends some parts of itself, but attacks with others. Thus the panther uses its teeth, the lion its nails and teeth, the horse its hoofs, the ox its horns, the cock its spurs, and the scorpion its sting", Porphyry 3.9.2). Voltaire (*Philosophical Dictionary*, 1764) objects heavily to Descartes ("What a pitiful, what a sorry thing to have said that animals are machines bereft of understanding and feeling, which perform their operations always in the same way, which learn nothing, perfect nothing", Voltaire. Animals) and emphasises learning and experience as main counterarguments. So does a French Jesuit, Guillaume-Hyacinthe Bougeant, perhaps a little less known author, who claims in his innovative *Amusement philosophique sur le language des bêtes* (1737) that animals are capable of cognition and communication as well as soul and language, although the latter is of a different type than in humans. David Hume, as we shall see, is even more hostile towards the mechanistic view.

A point of convergence of the two (and many other) perspectives is found in the Darwinian revolution, which we shall discuss at length below. After Charles Darwin, a consistent number of speculations is radically confirmed or denied on an empirical basis, and the bases for modern animal studies (including zoosemiotics) are unmistakably established.

The three authors we have chosen for this section are John Locke (1632–1704), David Hume (1711–1776), and Charles Darwin (1809–1882). The presence of the first two authors is understandable from a semiotic point of view (both of them have been crucial in the formation of modern semiotics), while Darwin's presence, in an animal-related context, is at once obvious, unavoidable and vital.

Of Locke, we have selected excerpts from *An Essay Concerning Human Understanding*, Book II "Of Ideas", particularly the 9th chapter, "Of perception" (paragraphs 11–13 and 15), the 10th chapter, “Of retention” (paragraph 10), and the 11th chapter, “Of discerning, and other operations of the mind” (paragraphs 5, 7, 10 and 11).

As for Hume, we focused on *A Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects*. From the part III, “Of knowledge and probability” of the book I, “Of the Understanding”, we have selected the section XVI, “Of the reason of animals”.

And with Darwin we have opted for a true proto-zoosemiotic work, *The Expression of the Emotions in Man and Animals*, namely the 2nd chapter of the “General principles of expression”.

Apart from being one of the most important proto-semioticians, John Locke had an ongoing interest in the medical, chemical and biological sciences (we should not forget that he was a doctor, too). In *An Essay Concerning Human Understanding* (1690), undoubtedly his last major, and possibly his greatest work in general, Locke offers some important reflections on animal cognition. In contrast to Descartes, in Locke we do not find any division comparable to the Cartesian *res extensa* and *res cogitans*. To him, matter is able to think. Neither do we find any suggestion that animal life is actually comparable to machines. The sole realm of life that can possibly be interpreted in mechanistic terms is to Locke the vegetal one: there, and there only, the subject is incapable of sensations and ideas, despite the obvious capacity of motion. What marks the difference between animals and plants is perception (*see p. 31, below*). Perception varies in grades according to the unique capacities of each species. Animals are organisms provided with sense, memory, and ability to make plans and comparisons, “though in some possibly the avenues provided by nature for the reception of sensations are so few, and the perception they are received with so obscure and dull, that it comes extremely short of the quickness and variety of sensation which is in other animals” (*see p. 31, below*). In some cases, like the entertaining example of the oyster, we are suggested that a—so to speak—excess of sensations would actually be “an inconvenience to an animal that must lie still where chance has once placed it, and there receive the afflux of colder or warmer, clean or foul water” (*see p. 31–32, below*).

After perception, which remains the core of any intellectual faculty (*see p. 32, below*), Locke proceeds by discussing both human and non-human memory and its capacity to activate reasoning. As an example, he offers the musical skills of birds, and particularly their capacity to “retain *ideas* in their memories, and use them for patterns” (*see p. 32, below*). Locke describes birds as wasting their time by re-composing their sound models, without any apparent advantage being secured for themselves or their own species. These birds are consequently able to sing *just for the sake of singing*, expending the same effort as they would if it were a matter of life or death. There follows a second reflection on the subject, subtly ironical towards Cartesianism. Memory, or the ability of taking up actions and thoughts from a recent or distant past, is in itself a negation of mechanism: the trace of yesterday, in a machine, "is now nowhere" (*see p. 32, below*).

The mental faculties of non-human animals remain anyway inferior, in degrees, to those of human beings. Ideas are composed and compared, but not on such a complex level as by humans. Animals do not count, and do not easily distinguish (*see p. 33, below*). And, most of all, the greatest sign of human distinction is the ability of abstraction, as "we observe no footsteps in them [other animals] of making use of general signs for universal *ideas*" (*see p. 33, below*).

Yet, Locke concludes his speculation by leaving no doubt that non-human animals "are not bare machines", and that "we cannot deny them to have some reason. It seems as evident to me that they do some of them in certain instances reason, as that they have sense" (*see p. 34, below*).

As a forerunner of utilitarianism, David Hume represents a radical cut with the "sick metaphysicians" (as he calls them) of the 17th century, i.e. Baruch Spinoza, Thomas Hobbes, and most of all Descartes, and an ideal (when not direct) continuity with Michel de Montaigne, Francis Bacon, Pierre Bayle, Isaac Newton, and of course Locke himself. By consequence, his considerations on non-human animals follow more closely a proto-evolutionary approach. Similarly to Locke earlier and to Darwin one century later, Hume makes it clear that the differences between humans and other animals are simply a matter of degree. His attack on Cartesianism is straightforward from the very start: "Next to the ridicule of denying an evident truth, is that of taking much pains to defend it; and no truth appears to me more evident, than that beasts are endowed with thought and reason as well as men. The arguments are in this case so obvious, that they never escape the most stupid and ignorant" (*see p. 35, below*).

Similarities between humans and other animals concern both the emotional and the intellectual area: all animals aim at seeking pleasure and avoiding pain, all animals care about their own life, all animals share the same principles at the basis of reasoning, "extraordinary instances of sagacity" that should clearly be distinguished from actions "which are of a vulgar nature" (*see p. 36, below*).

It is exactly on the issue of reasoning that Hume challenges the philosophical tradition. Reasoning, in Hume, departs from senses, imagination and, most of all, experience: it allows the act of deducing and believing that future (whether immediate or not) will conform to given expectations: "Beasts certainly never perceive any real connexion among objects. It is therefore by experience they infer one from another. They can never by any arguments form a general conclusion, that those objects of which they have had no experience, resemble those of which they have. It is therefore by means of custom alone, that experience operates upon them." (*see p. 36–37, below*). Hume argues against one of the very foundations of traditional philosophy: mathematic thought is not the expression of reason, but simply a consequence of senses and imagination (the "unintelligible instinct in our souls"). Reasoning, in humans and other animals, is thus caused by passions, but Hume does not mean to be an irrationalist: his goal is simply that of establishing an adequate causal relation between emotions, experience and feelings on the one hand and intellect, thought and act on the other[1].

Charles Darwin, as we have already said, is a fundamental figure for a great number of reasons, many of them not related with the theory of natural selection which brought him most of his fame. It is in his later works that we find the huge bequest to the study of cognitive ethology, zoosemiotics, animal psychology, and other fields that characterised animal studies in the 20th century. In *The Descent of Man, and Selection in Relation to Sex* (1871), the book preceding the one we selected for this volume, he introduces reflections and observations on animal cognition, reasoning, tool use, concepts, consciousness, learning, aesthetics, sociality and morality (and even spirituality, when we consider his remarks on the supernatural in animals). From this book also the concept of sexual selection, the results of which depend on "perception, the taste, and will" of animals (Darwin 1871: 296), is highly relevant for zoosemiotics.

Darwin's thoughts on the cognitive capabilities of animals inspired also some of his followers, for instance George J. Romanes, who has later become known as the establisher of comparative psychology. As a close friend and protégé of Darwin, Romanes tried to relate animal instinct and intelligence to evolution. He argued for the continuity of cognitive capacity (together with reflex and instinct) on an evolutionary scale and for the rise of communication systems and even language in the course of natural selection. In *Animal Intelligence* he

---

[1] Drawing from passages of the *Treatise* that we have not reported in this volume, it must be also noted that, although he excludes non-human animals from the idea of justice, Hume includes them in the idea of morality and ethics, and in fact asserts very clearly that the exclusion from justice has nothing to do with taking care of them. Morality, as founded on feelings like reason, is a primary virtue: justice is an artificial one. It is no coincidence that modern philosophical utilitarianism—inspired by Hume—includes many of the philosophers most concerned with the animal rights case (Peter Singer above all).

wrote: “there must be a psychological, no less than a physiological, continuity extending throughout the length and breadth of the animal kingdom” (Romanes 1882: 10). To supporting his views he used published stories rather than empirical research and mostly for that reason his works were rejected by the emerging behaviourism.

In the subsequent *The Expression of the Emotions in Man and Animals* (1872) Darwin follows up the arguments of the previous book, and focuses on topics that are fully pertinent to modern zoosemiotic research: signalling behaviour, representation and interpretation. A meticulous description of what we now call multimodal displays in a dog is provided in the beginning of the section here selected (*see p. 39, below*). Darwin, notoriously, relies upon the old-fashioned method of carefully observing and cataloguing his subjects. His descriptions are often anecdotal and non-invasive, in the sense that he does not *interfere* with the world in the attempt to understand it.

The stress of Darwin’s description of the dog (and, next, of a cat) is on the variety and the variability of actions and signs performed in response to the environment and its stimuli, and to forms of reasoning and intentionality that the British naturalist mentions matter-of-factly, without argumentation that to him is possibly pleonastic.

The zoosemiotic value of this and other writings by Darwin certainly relies on their modernity. Accurate descriptions of signalling behaviour, important methodological distinctions (intraspecific and interspecific communication, innate, learned and ritualised sign repertoires, etc.), and sheer theoretical formulations, like the principle of “antithesis”, are at the core of the section here selected. The heritage of Darwin is to zoosemiotics as Bach is to modern music.

References

Aristotle
s.a. *Historia Animalium*.
Aristotle
s.a. *Metaphysics*.
Guillaume-Hyacinthe Bougeant
1737 *Amusement Philosophique sur le Language des Bêtes*.
Charles R. Darwin
1871 *The Descent of Man, and Selection in Relation to Sex*.
Charles R. Darwin
1872 *The Expression of the Emotions in Man and Animals*.
Rene Descartes
1637 *Discourse on the Method of Rightly Conducting One’s Reason and of Seeking Truth in the Sciences*.

Immanuel Kant		
	1775–1780	*Lectures on Ethics*.
John Locke		
	1690	*An Essay Concerning Human Understanding*.
Porphyry		
	s.a.	*On Abstinence from Animal Food*.
George J. Romanes		
	1882	*Animal Intelligence*.
Thomas Aquinas		
	1265–1274	*Summa Theologica*.
Voltaire		
	1764	*Philosophical Dictionary*.

Of Ideas*

John Locke

Of Perception

11. This faculty of *perception* seems to me to be that which *puts the distinction betwixt the animal kingdom and the inferior parts of nature*. For, however vegetables have, many of them, some degrees of motion, and upon the different application of other bodies to them, do very briskly alter their figures and motions, and so have obtained the name of sensitive plants, from a motion which has some resemblance to that which in animals follows upon sensation: yet I suppose it is all bare mechanism, and no otherwise produced than the turning of a wild oat-beard by the insinuation of the particles of moisture, or the shortening of a rope by the affusion of water. All which is done without any sensation in the subject, or the having or receiving any *ideas.*

12. *Perception*, I believe, is, in some degree, *in all sorts of animals*; though in some possibly the avenues provided by nature for the reception of sensations are so few, and the perception they are received with so obscure and dull, that it comes extremely short of the quickness and variety of sensation which is in other animals; but yet it is sufficient for, and wisely adapted to, the state and condition of that sort of animals who are thus made, so that the wisdom and goodness of the Maker plainly appear in all the parts of this stupendous fabric and all the several degrees and ranks of creatures in it.

13. We may, I think, from the make of an *oyster* or *cockle* reasonably conclude that it has not so many, nor so quick senses as a man or several other animals; nor if it had would it, in that state and incapacity of transferring itself from one place to another, be bettered by them. What good would sight and hearing do to a creature that cannot move itself to or from the objects wherein at a distance it perceives good or evil? And would not quickness of sensation be an inconvenience to an animal that must lie still where chance has once placed

---

* From: Locke, John. *An Essay Concerning Human Understanding*. Book II. Of Ideas. Ch. IX. Of perception. 11–13, 15. Ch. X. Of retention. 10. Ch. XI. Of discerning, and other operations of the mind. 5, 7, 10, 11.

it, and there receive the afflux of colder or warmer, clean or foul water, as it happens to come to it?

15. *Perception* there being the *first step and degree towards knowledge and the inlet of all the materials of it*: the fewer senses any man, as well as any other creature, hath; and the fewer and duller the impressions are that are made by them; and the duller the faculties are that are employed about them: the more remote are they from that knowledge which is to be found in some men. But this, being in great variety of degrees (as may be perceived amongst men), cannot certainly be discovered in the several species of animals, much less in their particular individuals. It suffices me only to have remarked here that perception is the first operation of all our intellectual faculties, and the inlet of all knowledge in our minds. And I am apt, too, to imagine that it is perception in the lowest degree of it which puts the boundaries between animals and the inferior ranks of creatures. But this I mention only as my conjecture by the by, it being indifferent to the matter in hand which way the learned shall determine of it.

Of Retention

10. This faculty of laying up and retaining the *ideas* that are brought into the mind, several *other animals* seem to have to a great degree, as well as man. For, to pass by other instances, birds learning of tunes, and the endeavours one may observe in them to hit the notes right, put it past doubt with me that they have perception and retain *ideas* in their memories and use them for patterns. For it seems to me impossible that they should endeavour to conform their voices to notes (as it is plain they do) of which they had no *ideas*. For though I should grant sound may mechanically cause a certain motion of the animal spirits in the brains of those birds whilst the tune is actually playing; and that motion may be continued on to the muscles of the wings and so the bird mechanically be driven away by certain noises, because this may tend to the bird's preservation: yet that can never be supposed a reason why it should cause mechanically, either whilst the tune was playing, much less after it has ceased, such a motion in the organs of the bird's voice as should conform it to the notes of a foreign sound, which imitation can be of no use to the bird's preservation. But which is more, it cannot with any appearance of reason be supposed (much less proved) that birds, without sense and memory, can approach their notes nearer and nearer by degrees to a tune played yesterday; which, if they have no *idea* of in their memory, is now nowhere, nor can be a pattern for them to imitate, or which any repeated essays can bring them nearer to: since there is no reason why the sound of a pipe should leave traces in their brains which not at first but by their

after endeavours should produce the like sounds; and why the sounds they make themselves should not make traces which they should follow, as well as those of the pipe, is impossible to conceive.

Of Discerning, and Other Operations of the Mind

5. How far brutes partake in this faculty is not easy to determine. I imagine they have it not in any great degree: for though they probably have several *ideas* distinct enough, yet it seems to me to be the prerogative of human understanding, when it has sufficiently distinguished any *ideas*, so as to perceive them to be perfectly different and so consequently two, to cast about and consider in what circumstances they are capable to be compared. And therefore, I think, *beasts compare* not their *ideas* further than some sensible circumstances annexed to the objects themselves. The other power of comparing, which may be observed in men, belonging to general *ideas*, and useful only to abstract reasonings, we may probably conjecture beasts have not.

7. In this also, I suppose, *brutes* come far short of men. For, though they take in and retain together several combinations of simple *ideas,* as possibly the shape, smell, and voice of his master make up the complex *idea* a dog has of him, or rather are so many distinct marks whereby he knows him: yet I *do not* think they do of themselves ever compound them and *make complex* ideas. And perhaps even where we think they have complex *ideas*, it is only one simple one that directs them in the knowledge of several things, which possibly they distinguish less by their sight than we imagine. For I have been credibly informed that a bitch will nurse, play with, and be fond of young foxes, as much as and in place of her puppies, if you can but get them once to suck her so long that her milk may go through them. And those animals, which have a numerous brood of young ones at once, appear not to have any knowledge of their number; for though they are mightily concerned for any of their young that are taken from them whilst they are in sight or hearing, yet if one or two of them be stolen from them in their absence or without noise, they appear not to miss them or to have any sense that their number is lessened.

10. If it may be doubted whether *beasts* compound and enlarge their *ideas* that way to any degree: this, I think, I may be positive in, that the power of *abstracting* is not at all in them; and that the having of general *ideas* is that which puts a perfect distinction betwixt man and brutes, and is an excellency which the faculties of brutes do by no means attain to. For it is evident we observe no footsteps in them of making use of general signs for universal *ideas*; from which we have reason to imagine that they have not the faculty of abstracting,

or making general *ideas*, since they have no use of words or any other general signs.

11. Nor can it be imputed to their want of fit organs to frame articulate sounds that they have no use or knowledge of general words, since many of them, we find, can fashion such sounds and pronounce words distinctly enough, but never with any such application. And on the other side, men who through some defect in the organs want words, yet fail not to express their universal *ideas* by signs which serve them instead of general words, a faculty which we see beasts come short in. And therefore I think we may suppose that it is in this that the species of *brutes* are discriminated from man, and it is that proper difference wherein they are wholly separated and which at last widens to so vast a distance. For if they have any *ideas* at all and are not bare machines (as some would have them) we cannot deny them to have some reason. It seems as evident to me that they do some of them in certain instances reason, as that they have sense; but it is only in particular *ideas*, just as they received them from their senses. They are the best of them tied up within those narrow bounds and *have not* (as I think) the faculty to enlarge them by any kind of *abstraction.*

Of the Reason of Animals*

David Hume

Next to the ridicule of denying an evident truth, is that of taking much pains to defend it; and no truth appears to me more evident, than that the beasts are endowed with thought and reason as well as men. The arguments are in this case so obvious, that they never escape the most stupid and ignorant.

We are conscious that we ourselves, in adapting means to ends, are guided by reason and design, and that it is not ignorantly nor casually we perform those actions which tend to self-preservation, to the obtaining pleasure, and avoiding pain. When, therefore, we see other creatures, in millions of instances, perform like actions, and direct them to like ends, all our principles of reason and probability carry us with an invincible force to believe the existence of a like cause. It is needless, in my opinion, to illustrate this argument by the enumeration of particulars. The smallest attention will supply us with more than are requisite. The resemblance betwixt the actions of animals and those of men is so entire, in this respect, that the very first action of the first animal we shall please to pitch on, will afford us an incontestable argument for the present doctrine.

This doctrine is as useful as it is obvious, and furnishes us with a kind of touchstone, by which we may try every system in this species of philosophy. It is from the resemblance of the external actions of animals to those we ourselves perform, that we judge their internal likewise to resemble ours; and the same principle of reasoning, carried one step further, will make us conclude, that, since our internal actions resemble each other, the causes, from which they are derived, must also be resembling. When any hypothesis, therefore, is advanced to explain a mental operation, which is common to men and beasts, we must apply the same hypothesis to both; and as every true hypothesis will abide this trial, so I may venture to affirm, that no false one will ever be able to endure it. The common defect of those systems, which philosophers have employed to account for the actions of the mind, is, that they suppose such a subtilty and refinement of thought, as not only exceeds the capacity of mere animals, but

---

* From: Hume, David. *A Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects*. Book I. Of the Understanding. Part III. Of knowledge and probability. Sect. XVI. Of the reason of animals.

even of children and the common people in our own species; who are, notwithstanding, susceptible of the same emotions and affections as persons of the most accomplished genius and understanding. Such a subtilty is a clear proof of the falsehood, as the contrary simplicity of the truth, of any system.

Let us, therefore, put our present system, concerning the nature of the understanding, to this decisive trial, and see whether it will equally account for the reasonings of beasts as for those of the human species.

Here we must make a distinction betwixt those actions of animals, which are of a vulgar nature, and seem to be on a level with their common capacities, and those more extraordinary instances of sagacity, which they sometimes discover for their own preservation, and the propagation of their species. A dog that avoids fire and precipices, that shuns strangers, and caresses his master, affords us an instance of the first kind. A bird, that chooses with such care and nicety the place and materials of her nest, and sits upon her eggs for a due time, and in a suitable season, with all the precaution that a chemist is capable of in the most delicate projection, furnishes us with a lively instance of the second.

As to the former actions, I assert they proceed from a reasoning, that is not in itself different, nor founded on different principles, from that which appears in human nature. It is necessary, in the first place, that there be some impression immediately present to their memory or senses, in order to be the foundation of their judgment. From the tone of voice the dog infers his master's anger, and foresees his own punishment. From a certain sensation affecting his smell, he judges his game not to be far distant from him.

Secondly, the inference he draws from the present impression is built on experience, and on his observation of the conjunction of objects in past instances. As you vary this experience, he varies his reasoning. Make a beating follow upon one sign or motion for some time, and afterwards upon another; and he will successively draw different conclusions, according to his most recent experience.

Now, let any philosopher make a trial, and endeavour to explain that act of the mind which we call *belief*, and give an account of the principles from which it is derived, independent of the influence of custom on the imagination, and let his hypothesis be equally applicable to beasts as to the human species; and, after he has done this, I promise to embrace his opinion. But, at the same time I demand as an equitable condition, that if my system be the only one, which can answer to all these terms, it may be received as entirely satisfactory and convincing. And that it is the only one is evident almost without any reasoning. Beasts certainly never perceive any real connection among objects. It is therefore by experience they infer one from another. They can never by any arguments form a general conclusion, that those objects of which they have had no experience, resemble those of which they have. It is therefore by means of custom alone that experience operates upon them. All this was sufficiently evident with respect to man. But with respect to beasts there cannot be the least suspicion of mistake; which must be owned to be a strong confirmation, or rather an invincible proof of my system.

Nothing shows more the force of habit in reconciling us to any phenomenon, than this, that men are not astonished at the operations of their own reason, at the same time that they admire the *instinct* of animals, and find a difficulty in explaining it, merely because it cannot be reduced to the very same principles. To consider the matter aright, reason is nothing but a wonderful and unintelligible instinct in our souls, which carries us along a certain train of ideas, and endows them with particular qualities, according to their particular situations and relations. This instinct, it is true, arises from past observation and experience; but can any one give the ultimate reason why past experience and observation produces such an effect, any more than why nature alone should produce it? Nature may certainly produce whatever can arise from habit: nay, habit is nothing but one of the principles of nature, and derives all its force from that origin.

General Principles of Expression*

Charles Darwin

We will now consider our second Principle, that of Antithesis. Certain states of the mind lead, as we have seen in the last chapter, to certain habitual movements which were primarily, or may still be, of service; and we shall find that when a directly opposite state of mind is induced, there is a strong and involuntary tendency to the performance of movements of a directly opposite nature, though these have never been of any service. A few striking instances of antithesis will be given, when we treat of the special expressions of man; but as, in these cases, we are particularly liable to confound conventional or artificial gestures and expressions with those which are innate or universal, and which alone deserve to rank as true expressions, I will in the present chapter almost confine myself to the lower animals.

When a dog approaches a strange dog or man in a savage or hostile frame of mind he walks upright and very stiffly; his head is slightly raised, or not much lowered; the tail is held erect and quite rigid; the hairs bristle, especially along the neck and back; the pricked ears are directed forwards, and the eyes have a fixed stare: (see figs. 1 and 3). These actions, as will hereafter be explained, follow from the dog's intention to attack his enemy, and are thus to a large extent intelligible. As he prepares to spring with a savage growl on his enemy, the canine teeth are uncovered, and the ears are pressed close backwards on the head; but with these latter actions, we are not here concerned. Let us now suppose that the dog suddenly discovers that the man whom he is approaching, is not a stranger, but his master; and let it be observed how completely and instantaneously his whole bearing is reversed. Instead of walking upright, the body sinks downwards or even crouches, and is thrown into flexuous movements; his tail, instead of being held stiff and upright, is lowered and wagged from side to side; his hair instantly becomes smooth; his ears are depressed and drawn backwards, but not closely to the head; and his lips hang loosely. From the drawing back of the ears, the eyelids become elongated, and the eyes no longer

---

* From: Darwin, Charles. *The Expression of the Emotions in Man and Animals*. Ch. II. General principles of expression, cont., 50–65. London: John Murray 1873.

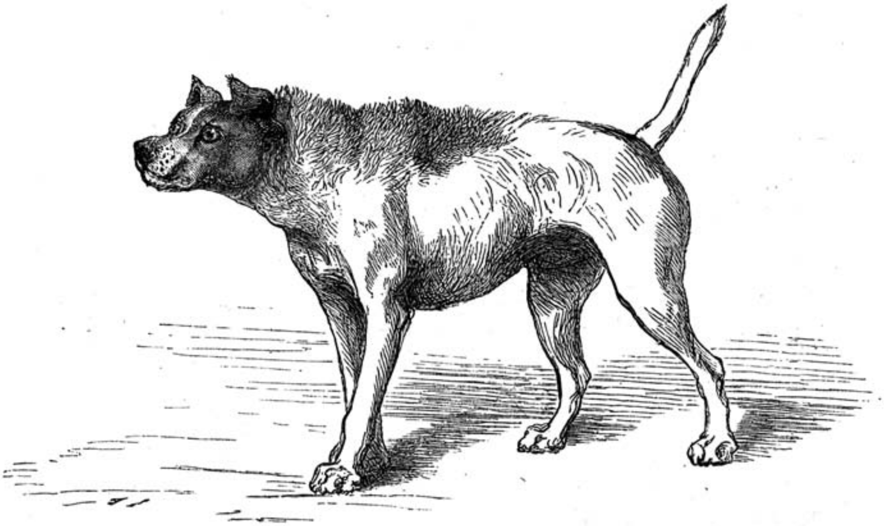


Figure 1. Dog approaching another dog with hostile intentions. By Mr. Riviere.

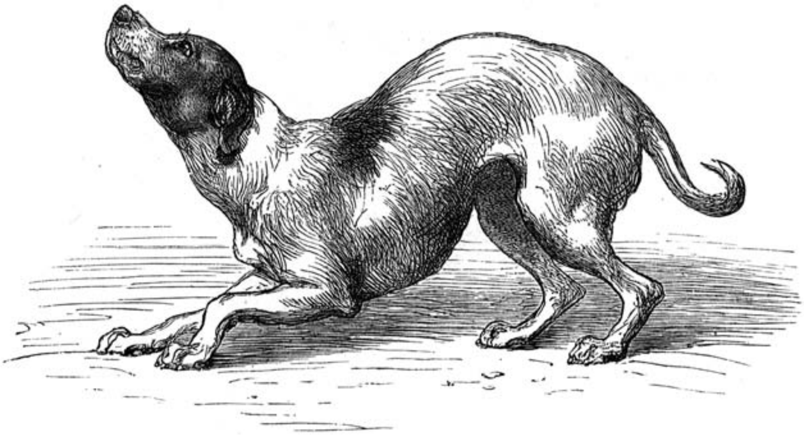


Figure 2. The same in a humble and affectionate state of mind. By Mr. Riviere.

Figure 3. Half-bred Shepherd Dog in the same state as in Fig. 1. By Mr. Riviere.

Figure 4. The same caressing his master. By Mr. Riviere.

appear round and staring. It should be added that the animal is at such times in an excited condition from joy; and nerve-force will be generated in excess, which naturally leads to action of some kind. Not one of the above movements, so clearly expressive of affection, are of the least direct service to the animal. They are explicable, as far as I can see, solely from being in complete opposition or antithesis to the attitude and movements which, from intelligible causes, are assumed when a dog intends to fight, and which consequently are expressive of anger. I request the reader to look at the four accompanying sketches, which have been given in order to recall vividly the appearance of a dog under these two states of mind. It is, however, not a little difficult to represent affection in a dog, whilst caressing his master and wagging his tail, as the essence of the expression lies in the continuous flexuous movements.

We will now turn to the cat. When this animal is threatened by a dog, it arches its back in a surprising manner, erects its hair, opens its mouth and spits. But we are not here concerned with this well-known attitude, expressive of terror combined with anger; we are concerned only with that of rage or anger. This is not often seen, but may be observed when two cats are fighting together; and I have seen it well exhibited by a savage cat whilst plagued by a boy. The attitude is almost exactly the same as that of a tiger disturbed and growling over its food, which every one must have beheld in menageries. The animal assumes a crouching position, with the body extended; and the whole tail, or the tip alone, is lashed or curled from side to side. The hair is not in the least erect. Thus far, the attitude and movements are nearly the same as when the animal is prepared to spring on its prey, and when, no doubt, it feels savage. But when preparing to fight, there is this difference, that the ears are closely pressed backwards; the mouth is partially opened, showing the teeth; the fore feet are occasionally struck out with protruded claws; and the animal occasionally utters a fierce growl. (See figs. 5 and 6.) All, or almost all, these actions naturally follow (as hereafter to be explained), from the cat's manner and intention of attacking its enemy.

Let us now look at a cat in a directly opposite frame of mind, whilst feeling affectionate and caressing her master; and mark how opposite is her attitude in every respect. She now stands upright with her back slightly arched, which makes the hair appear rather rough, but it does not bristle; her tail, instead of being extended and lashed from side to side, is held quite stiff and perpendicularly upwards; her ears are erect and pointed; her mouth is closed; and she rubs against her master with a purr instead of a growl. Let it further be observed how widely different is the whole bearing of an affectionate cat from that of a dog, when with his body crouching and flexuous, his tail lowered and wagging, and ears depressed, he caresses his master. This contrast in the attitudes

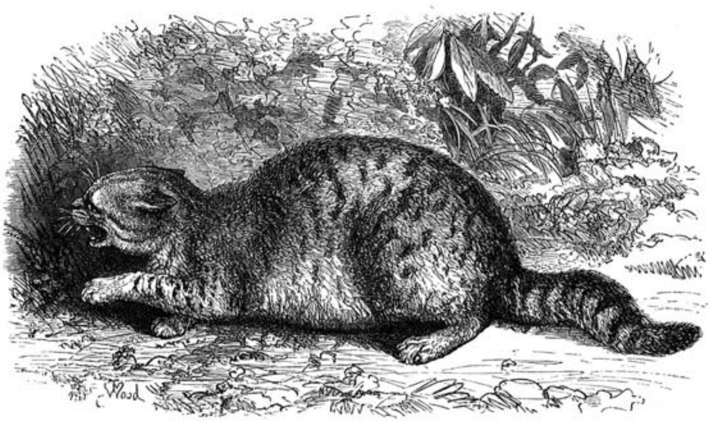


Figure 5. Cat, savage, and prepared to fight. Drawn from life by Mr. Wood.

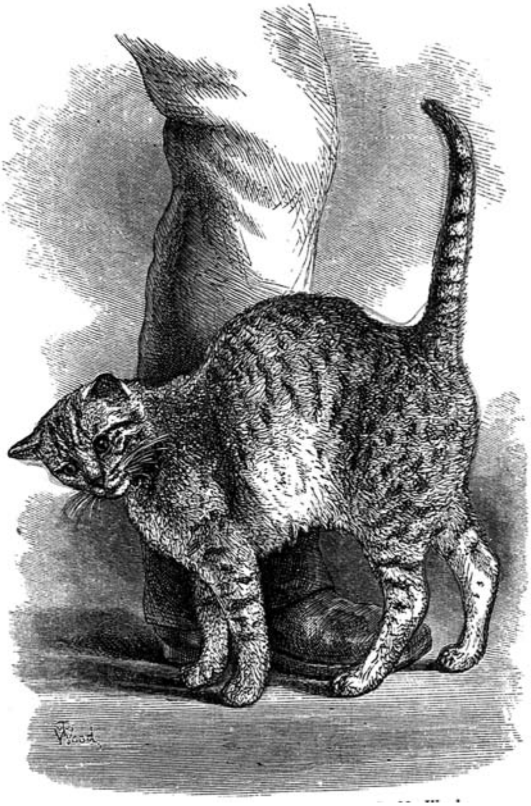


Figure 6. Cat in an affectionate frame of mind. By Mr. Wood.

and movements of these two carnivorous animals, under the same pleased and affectionate frame of mind, can be explained, as it appears to me, solely by their movements standing in complete antithesis to those which are naturally assumed, when these animals feel savage and are prepared either to fight or to seize their prey.

In these cases of the dog and cat, there is every reason to believe that the gestures both of hostility and affection are innate or inherited; for they are almost identically the same in the different races of the species, and in all the individuals of the same race, both young and old.

I will here give one other instance of antithesis in expression. I formerly possessed a large dog, who, like every other dog, was much pleased to go out walking. He showed his pleasure by trotting gravely before me with high steps, head much raised, moderately erected ears, and tail carried aloft but not stiffly. Not far from my house a path branches off to the right, leading to the hot-house, which I used often to visit for a few moments, to look at my experimental plants. This was always a great disappointment to the dog, as he did not know whether I should continue my walk; and the instantaneous and complete change of expression which came over him, as soon as my body swerved in the least towards the path (and I sometimes tried this as an experiment) was laughable. His look of dejection was known to every member of the family, and was called his *hot-house face.* This consisted in the head drooping much, the whole body sinking a little and remaining motionless; the ears and tail falling suddenly down, but the tail was by no means wagged. With the falling of the ears and of his great chaps, the eyes became much changed in appearance, and I fancied that they looked less bright. His aspect was that of piteous, hopeless dejection; and it was, as I have said, laughable, as the cause was so slight. Every detail in his attitude was in complete opposition to his former joyful yet dignified bearing; and can be explained, as it appears to me, in no other way, except through the principle of antithesis. Had not the change been so instantaneous, I should have attributed it to his lowered spirits affecting, as in the case of man, the nervous system and circulation, and consequently the tone of his whole muscular frame; and this may have been in part the cause.

We will now consider how the principle of antithesis in expression has arisen. With social animals, the power of intercommunication between the members of the same community,—and with other species, between the opposite sexes, as well as between the young and the old,—is of the highest importance to them. This is generally effected by means of the voice, but it is certain that gestures and expressions are to a certain extent mutually intelligible. Man not only uses inarticulate cries, gestures, and expressions, but has invented articulate language; if, indeed, the word *invented* can be applied to a process, completed by innumerable steps, half-consciously made. Any one who has watched monkeys will not doubt that they perfectly understand each other's gestures and expression, and to a large extent, as Rengger asserts,[1] those of man. An animal when going to attack another, or when afraid of another, often makes itself appear terrible, by erecting its hair, thus increasing the apparent bulk of its body, by showing its teeth, or brandishing its horns, or by uttering fierce sounds.

As the power of intercommunication is certainly of high service to many animals, there is no *à priori* improbability in the supposition, that gestures manifestly of an opposite nature to those by which certain feelings are already expressed, should at first have been voluntarily employed under the influence of an opposite state of feeling. The fact of the gestures being now innate, would be no valid objection to the belief that they were at first intentional; for if practised during many generations, they would probably at last be inherited. Nevertheless it is more than doubtful, as we shall immediately see, whether any of the cases which come under our present head of antithesis, have thus originated.

With conventional signs which are not innate, such as those used by the deaf and dumb and by savages, the principle of opposition or antithesis has been partially brought into play. The Cistercian monks thought it sinful to speak, and as they could not avoid holding some communication, they invented a gesture language, in which the principle of opposition seems to have been employed.[2] Dr. Scott, of the Exeter Deaf and Dumb Institution, writes to me that "opposites are greatly" used in teaching the deaf and dumb, who have a lively "sense of them." Nevertheless I have been surprised how few unequivocal instances can be adduced. This depends partly on all the signs having commonly had some natural origin; and partly on the practice of the deaf and dumb and of savages to contract their signs as much as possible for the sake of rapidity.[3] Hence their natural source or origin often becomes doubtful or is completely lost; as is likewise the case with articulate language.

---

[1] 'Naturgeschichte der Säugethiere von Paraguay,' 1830, s. 55.

[2] Mr. Tylor gives an account of the Cistercian gesture-language in his 'Early History of Mankind' (2nd edit. 1870, p. 40), and makes some remarks on the principle of opposition in gestures.

[3] See on this subject Dr. W. R. Scott's interesting work, 'The Deaf and Dumb,' 2nd edit. 1870, p. 12. He says, "This contracting of natural gestures into much shorter gestures than the natural expression requires, is very common amongst the deaf and dumb. This contracted gesture is frequently so shortened as nearly to lose all semblance of the natural one, but to the deaf and dumb who use it, it still has the force of the original expression."

Many signs, moreover, which plainly stand in opposition to each other, appear to have had on both sides a significant origin. This seems to hold good with the signs used by the deaf and dumb for light and darkness, for strength and weakness, &c. In a future chapter I shall endeavour to show that the opposite gestures of affirmation and negation, namely, vertically nodding and laterally shaking the head, have both probably had a natural beginning. The waving of the hand from right to left, which is used as a negative by some savages, may have been invented in imitation of shaking the head; but whether the opposite movement of waving the hand in a straight line from the face, which is used in affirmation, has arisen through antithesis or in some quite distinct manner, is doubtful.

If we now turn to the gestures which are innate or common to all the individuals of the same species, and which come under the present head of antithesis, it is extremely doubtful, whether any of them were at first deliberately invented and consciously performed. With mankind the best instance of a gesture standing in direct opposition to other movements, naturally assumed under an opposite frame of mind, is that of shrugging the shoulders. This expresses impotence or an apology,—something which cannot be done, or cannot be avoided. The gesture is sometimes used consciously and voluntarily, but it is extremely improbable that it was at first deliberately invented, and afterwards fixed by habit; for not only do young children sometimes shrug their shoulders under the above states of mind, but the movement is accompanied, as will be shown in a future chapter, by various subordinate movements, which not one man in a thousand is aware of, unless he has specially attended to the subject.

Dogs when approaching a strange dog, may find it useful to show by their movements that they are friendly, and do not wish to fight. When two young dogs in play are growling and biting each other's faces and legs, it is obvious that they mutually understand each other's gestures and manners. There seems, indeed, some degree of instinctive knowledge in puppies and kittens, that they must not use their sharp little teeth or claws too freely in their play, though this sometimes happens and a squeal is the result; otherwise they would often injure each other's eyes. When my terrier bites my hand in play, often snarling at the same time, if he bites too hard and I say *gently*, *gently*, he goes on biting, but answers me by a few wags of the tail, which seems to say "Never mind, it is all fun." Although dogs do thus express, and may wish to express, to other dogs and to man, that they are in a friendly state of mind, it is incredible that they could ever have deliberately thought of drawing back and depressing their ears, instead of holding them erect,—of lowering and wagging their tails, instead of keeping them stiff and upright, &c., because they knew that these movements stood in direct opposition to those assumed under an opposite and savage frame of mind.

Again, when a cat, or rather when some early progenitor of the species, from feeling affectionate first slightly arched its back, held its tail perpendicularly upwards and pricked its ears, can it be believed that the animal consciously wished thus to show that its frame of mind was directly the reverse of that, when from being ready to fight or to spring on its prey, it assumed a crouching attitude, curled its tail from side to side and depressed its ears? Even still less can I believe that my dog voluntarily put on his dejected attitude and "*hot-house face*," which formed so complete a contrast to his previous cheerful attitude and whole bearing. It cannot be supposed that he knew that I should understand his expression, and that he could thus soften my heart and make me give up visiting the hot-house.

Hence for the development of the movements which come under the present head, some other principle, distinct from the will and consciousness, must have intervened. This principle appears to be that every movement which we have voluntarily performed throughout our lives has required the action of certain muscles; and when we have performed a directly opposite movement, an opposite set of muscles has been habitually brought into play,—as in turning to the right or to the left, in pushing away or pulling an object towards us, and in lifting or lowering a weight. So strongly are our intentions and movements associated together, that if we eagerly wish an object to move in any direction, we can hardly avoid moving our bodies in the same direction, although we may be perfectly aware that this can have no influence. A good illustration of this fact has already been given in the Introduction, namely, in the grotesque movements of a young and eager billiardplayer, whilst watching the course of his ball. A man or child in a passion, if he tells any one in a loud voice to begone, generally moves his arm as if to push him away, although the offender may not be standing near, and although there may be not the least need to explain by a gesture what is meant. On the other hand, if we eagerly desire some one to approach us closely, we act as if pulling him towards us; and so in innumerable other instances.

As the performance of ordinary movements of an opposite kind, under opposite impulses of the will, has become habitual in us and in the lower animals, so when actions of one kind have become firmly associated with any sensation or emotion, it appears natural that actions of a directly opposite kind, though of no use, should be unconsciously performed through habit and association, under the influence of a directly opposite sensation or emotion. On this principle alone can I understand how the gestures and expressions which come under the present head of antithesis have originated. If indeed they are serviceable to man or to any other animal, in aid of inarticulate cries or language, they will likewise be voluntarily employed, and the habit will thus be strengthened. But whether or not of service as a means of communication, the tendency to perform opposite movements under opposite sensations or emotions would, if we may judge by analogy, become hereditary through long practice; and there cannot be a doubt that several expressive movements due to the principle of antithesis are inherited.

Essentials in Zoosemiotics

Introduction

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

This section of the reader contains essential works of zoosemiotics that are prerequisites for understanding the zoosemiotic paradigm. These are the chapters "The meaning-carrier" and "The theory of composition of nature" from Jakob von Uexküll's book *The Theory of Meaning* and three essays by Thomas A. Sebeok: "Zoosemiotics: At the intersection of nature and culture", "'Talking' with animals: Zoosemiotics explained", and "The word 'Zoosemiotics'".

As mentioned in the general introduction, the history and methodological issues of zoosemiotics and biosemiotics largely overlap, and thus also the basic writings, presented in this section, have influenced all paradigms studying the semiotics of nature (zoo-, eco-, biosemiotics). This is especially true of the legacy of Jakob von Uexküll (1864–1944), a Baltic-German biologist, whose role in developing a semiotic approach in biology cannot be overestimated. Especially significant in that aspect is his book *Bedeutungslehre* (*Theory of Meaning*) 1940 (other essential writings include *Umwelt und Innenwelt der Tiere*, 1909; *Theoretische Biologie*, 1920). *Theory of Meaning*, from where also two passages for our reader have been selected, develops a certain subjective view of nature, where perceptual worlds of the organisms—Umwelten, and organisms' meaningful relations to their environment—have a central organizing role.

Uexküll himself is a fascinating, important, but nowadays largely neglected and forgotten figure in the history of biology. As a student of the University of Tartu, he carried on and elaborated the tradition of German biological thinking as it is manifested for instance in the works of J. W. v. Goethe and K. E. von Baer. Uexküll was also significantly influenced by Kantian philosophy. Profound theoretical and philosophical interests, however, do not mean lack of experience in wild nature or in the laboratory. Uexküll was a keen observer and quite experienced in fieldwork. His early scientific works concerned the physiology of nerves and muscles in the animal body; later he turned to marine biology. As a teacher of Konrad Lorenz, Uexküll has significantly influenced also the development of ethology and studies of animal behaviour. It has been argued that ethological concepts like "sign stimuli", "innate release mechanism" or "search image" have their origin in Uexküll's writings. Uexküll's own works were, however, soon forgotten, partly because of Darwinian biology's harsh rejection of anything that could be interpreted as vitalistic, and partly also because of the general neglect toward German-language and German-minded science after the Second World War. It has only been over the last few decades that Jakob von Uexküll's legacy has slowly been rediscovered and in this process biosemioticians have had a leading role (see Kull 2001, 2004).

For elaborating the zoosemiotic paradigm, Uexküllian thinking provides several intriguing starting points. A possibility to develop a pluralistic view on animal communication and the possible zoosemiotic implications of Umwelt-theory were discussed in the general introduction to this volume, above. Besides that, the Uexküllian approach underlines the need to synthesize theoretical-philosophical views with practical studies on organism–environment relations. It also highlights complex relations between the semiotic realm (*meanings*, *tones*) and physical realm (*body-plans*, physiology of sense organs). Keeping in mind that meanings are rooted in physical nature helps to avoid the danger faced by the semiotic community to get lost in over-theorizations and scholastic speculations. Also, while approaches of linguistic origin tend to search distinct meaningful word-like units in animal communication, the Uexküllian approach is in contrast surprisingly close to earth, showing for instance, how being in the world or embodiment itself can be meaningful, like the body of a hermit crab fitting into the shell of sea snail, or the body of an octopus fitting into the relationship with seawater (*see p. 68, below*). Such questions are often not treated by anthroposemiotics, since in the intraspecific communication between humans, body structures, organs used for perceptions and expressions are just invariants. For the comparative perspective of zoosemiotics, by contrast, the embodiment of meaning has central importance.

The chapter of the "Theory of Meaning" presented in this reader includes two passages. The first one of them presents in a condensed form, the basic arguments of Umwelt theory, thus providing an introduction to Uexküllian thinking. The second passage discusses specific meaningful relationships between organisms and environment as well as between different organisms. This is an important point to remember—Uexküll's work includes also theorization of organism–organism relations of meaning that fits well with the zoosemiotic paradigm.

Based on the selected passages the key issues of Uexküll's view of nature as a composition of animal Umwelten can be explicated as follows:

1. The completeness and closeness of the Umwelt. "Each Umwelt forms a closed unit in itself, which is governed, in all its parts, by the meaning it has for the subject" (*see p. 65, below*). The subjective world of an animal is

organized according to the basic meanings and meaning relations that an animal can make use of in its physical environment. Also other organisms and their body structures become subordinated to these meanings. At the same time Umwelt limits the animal, who cannot reach behind the borders of its Umwelt, use other senses, as the ones given to it, or, in relating with the environment, apply any other meanings than those present in its Umwelt.

2. There are no neutral objects and no object is neutral. "They [animals] never enter into relationships with neutral objects. Through every relationship the neutral object is transformed into a meaning-carrier, the meaning of which is imprinted to it by a subject" (*see p. 62, below*). This principle states that no object can be perceived in some absolute or abstract way, outside an animal's Umwelt, but also that in their Umwelten animals (or humans, for that matter) do not relate with objects in an abstract way. An object in the animal's subjective world is always given as something, with some meaning or reference. These meaning relations can change depending on the change of the properties of objects or their position regarding environmental context or animals' motivational or developmental stage, but in some form or another meaning relations are always there.
3. Animal Umwelten are composed of discrete structures. Discreteness as opposed to continuity is one of the central traits of Uexküll's thinking. Space and time in an animal's Umwelt have a discrete structure by being composed of minimal units perceivable to that particular animal—localities or moments (see also Uexküll 1992). Also the organization of meanings in animal Umwelten is discrete, which makes it possible to use musical terminology (e.g. tone, point/counterpoint) for describing animal Umwelten. The same applies to the relationship between organisms and environment—the relationship has a specific cyclical structure (functional cycle), composed of perception and action/effect, both in their own turn consisting of a given organ and the fitting environmental object as sign-carriers that match each other.

The discreet nature of functional cycles allows Uexküll to show how in Nature different Umwelten and body structures of animals fit together in various combinations, producing meaningful structures on a higher level of the ecosystem that can be metaphorically described as the melody of nature. Uexküll's *Theory of Meaning* should thus radically change the way how we regard whole ecosystems as well as communicative relations between animals. That is, a natural environment can be seen as composed of Umwelten the relations of which are mediated by functional cycles. For instance, in the semiotic sense it is not possible to talk anymore about the forest as such, but about the forest as manifested in a multitude of different Umwelten: an Umwelt of man, an Umwelt of fox, ant, owl, etc., and about the ways these different Umwelten partly overlap and intersect with each-other.

The idea of nature as composed of Umwelten is not just meant as a theoretical consideration: it can also be a strong methodological tool for semiotic analysis. In *Theory of Meaning* (*see p. 72, below*) Uexküll shows how to implement this approach in practical analysis by bringing an example of a tick's use of its Umwelt and the position in it of warm-blooded mammal. As the first step of an analysis, Uexküll specifies the affiliation of the subject (meaning receiver) and that of the object (meaning carrier). As the second step, Uexküll describes correspondences between body structures, sense organs, activities and Umwelten of animals as duets of points and counterpoints. The number and diversity of such correspondences shows the strength of relation and the reliability of the analysis. As the final part of the analysis, Uexküll arrives at the common meaning rule that brings two organisms into relation. Such a type of analysis can be conducted to describe the variety of semiotic relations in nature. In practical zoosemiotic research it may help to explicate the central theme in the communicative relation between species that then further fulfils and organizes single acts of communication and messages changed and interpreted.

Juxtaposing Jakob von Uexküll and Thomas A. Sebeok in the same section of this Reader is not a coincidence. There is also a strong historical linkage between the two thinkers. Sebeok valued Uexküll highly and was also one of his main popularisers in the semiotic community, especially in frequent references to Uexküll we find in Sebeok's later zoosemiotic writings. Sebeok emphasizes Uexküll's studies of phenomenal worlds and functional cycles of animals and relates these to his own interest in models and modelling activity (Sebeok 1990: 119, 127). This enabled Sebeok to form a critical stance towards the division between primary and secondary modeling systems used in Tartu semiotics and claim that these are preceded by yet another—a zoosemiotic or nonverbal modelling system, where the environment is perceived and distinguished into meaningful units and these are matched with the effectual capabilities of the organism (Sebeok 1991b). Sebeok's interpretation of Uexküll's key concept in *Theory of Meaning* as a primary modelling of one's environment is developed further toward practical methodology in book *The Forms of Meaning. Modeling Systems Theory and Semiotic Analysis* (2000) written together with Marcel Danesi.

The semiotic legacy of Thomas A. Sebeok is huge and would certainly deserve special attention in the form of a separate Reader or numerous monographs. His interests included Fenno-Ugric linguistics, folklore research, the history of semiotics, theoretical issues of semiotics and communication, in other words, his interests go far beyond the scope of the present Reader. Regarding zoosemiotics, however, the essential collections of Thomas A. Sebeok's works are:

Sebeok, Thomas A.
1972 *Perspectives in Zoosemiotics*. (Janua Linguarum. Series Minor 122). The Hague: Mouton de Gruyter.
Sebeok, Thomas A.
1990 *Essays in Zoosemiotics*. (Monograph Series of the TSC 5). Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto.

These two books include Thomas A. Sebeok's selected essays on semiotics of animal communication, the relations of semiotics and biological disciplines, and the theory and history of zoosemiotics. Beside these groundworks of zoosemiotics Thomas A. Sebeok also compiled and edited several collections of papers on the theory and empirical studies of animal communication that deserve the attention of researchers or students interested in zoosemiotics:

Sebeok, Thomas A. (ed.)
1968 *Animal Communication: Techniques of Study and Results of Research*. Bloomington: Indiana University Press.
Sebeok, Thomas A. and Alexandra Ramsay (eds.)
1969 *Approaches to Animal Communication*. The Hague: Mouton de Gruyter.
Sebeok, Thomas A. (ed.)
1977 *How Animals Communicate*. Bloomington: Indiana University Press.

Thus the importance of Thomas A. Sebeok for the field of zoosemiotics both regarding the amount of texts and their relevance is breathtaking. In this section we limit our focus only on those writings that explicitly define or develop the discipline of zoosemiotics. "Zoosemiotics: At the intersection of nature and culture" observes mostly the background and the historical roots of zoosemiotics, including both semiotic and biological sources. " 'Talking' with animals: Zoosemiotics explained" is an in-depth overview of the zoosemiotic paradigm that focuses especially on human–animal relationships, and develops theoretical groundwork of zoosemiotics in this frame. "The word 'Zoosemiotics'" is a short text about the story of the word "zoosemiotics", its etymology and early occurrences in the scientific community.

These texts share several common features and standpoints that deserve to be brought out and commented on here. Especially in "Zoosemiotics: At the intersection of nature and culture" Sebeok reflects about the possible foundations of zoosemiotics and its place among other disciplines. He cannot help but point out the fixation on language and anthropocentrism of semiotics in general (this especially applies to the European tradition of semiology), and only the Peirce–Morris tradition of semiotics as a suitable groundwork for zoosemiotic studies. Also, in Sebeok's interpretation, zoosemiotics is a paradigm of semiotics that turns towards the natural sciences, especially towards studies of animal behaviour and communication. Sebeok's definition of zoosemiotics as an intersection of semiotics and ethology (*see p. 79, below*) is not meant to be a metaphor, but a proclamation to develop a real research program. Also, in the same vein, Sebeok argues that on the level of basic understandings (for instance concerning reproduction and communication) there is no initial conflict between semiotics and natural sciences, or that possible disagreements can be overcome. Sebeok notes resemblances between the semiotic and ethological terminology, drawing for instance parallels between the notions of "ethogram" and "communicative code" and those of "display" and "sign" (*see p. 80–81, below*). Unfortunately, Sebeok's initiative did not find many followers in ethology. Some of the few early contributions have been listed in "The word "Zoosemiotics"", some have been also included in the next section of our reader.

In the final part of "'Talking' with animals: Zoosemiotics explained" Sebeok develops a research program of zoosemiotics that has great didactic value, consists of six research questions and should be applicable also in practical research (*see p. 92–93, below*). This research program is based on Sebeok's semiotic interpretation of the transmissional communication model and characterizes quite well Sebeok's overall approach to animal communication. Compared to the classical model e.g. Shannon and Weaver's schema of communication, semiotic features are notably in the foreground. Sebeok distinguishes six aspects of the communication model: source, destination, channel, code, message, context (Sebeok 1972: 123), and four transformations that take place in communication: formulation, encoding, decoding, and interpretation (Sebeok 1991a: 28–29). These can be further organized between three dimensions of study: zoosyntactics, zoosemantics, and zoopragmatics. This general model makes its first appearance in the beginning of the 1960s and it is later repeated and developed with terminological variations and different emphases throughout his oeuvre.

As a long-time general editor of the journal *Semiotica* and series *Approaches to Semiotics*, *Advances in Semiotics*, *The Semiotic Web* inter alia, Sebeok had a role as a kind of "gatekeeper" of semiotics, shaping and directing the development of the discipline in general and especially caring for his favourite child—zoosemiotics. Foremost, his endeavour can be seen as keeping zoosemiotics as a true academic discipline on a track and at a distance from esoteric views (there are many of those related to animals and animal communication) as well as from strongly ideological approaches. Because of his unique position, Sebeok's views on the identity and limits of zoosemiotics deserve special attention as they help us to understand better the story of zoosemiotics. One controversial topic is the continuity/discontinuity debate and the position of human language among other communication systems in nature (see also the general introduction, above). We see here, first, that Sebeok repeatedly presents his conviction that talking about language in other animals beside humans can only be metaphoric and it would be better to completely avoid this terminology at all. This position goes hand-in-hand with the understanding that human language should stay outside the scope of zoosemiotics, although nonverbal communication of humans is definitely part of it. Such a position is related to Sebeok's criticism of research programmes concerned with the 'language' of apes, dolphins and other mammals and has probably created a distance between zoosemiotics and modern studies of the "animal mind", i.e. cognitive ethology.

On a closer inspection, we see, however, that Sebeok's argumentation is more articulate and his standpoint carefully positioned between the possible extremes of the continuity/discontinuity debate. His understanding of language is a linguistic one—emphasizing the specific structural organization that allows, based on certain rules, the possibility of combining smaller and stable units into a potentially infinite number of sentences (*see p. 80, below*). Such a complex syntactic system is indeed a peculiarity of our species, and there is no other animal capable of organizing and spreading information for instance in the form of academic presentations or rhymed poetry. As a species-specific feature, human language holds, however, a similar position to the echolocation of bats or the drumming of woodpeckers. Species-specificity of syntax-based language is, in fact, also exactly the reason it falls outside the scope of interest of zoosemiotics. Zoosemiotics is a comparative discipline of semiosis and communication in animals, whereas linguistics and literary studies can be considered as specific disciplines interested only in communicative capabilities of one species, being thus at the same time less and more than zoosemiotics.

On the other hand, neither does Sebeok support the view of discontinuity between animal and human sign systems. This is quite evident from his overall stance that semiosis is "a universal, critical property of animate existence" (*see p. 86, below*). In contrast to Umberto Eco (1976: 5–6) and many other representatives of European semiotics he lowers the threshold of the sphere of semiotic activity to include the activities of all living organisms. Also Sebeok's views on symbolicity and symbolic signs in animals are significant in this aspect. It is a common approach to reserve the use of symbolic signs together with the concepts of arbitrariness and conventionality to humans only. Sebeok, however, proceeding from Peircean terminology, attributes the capability to employ wholly arbitrary symbols also to other animals, using the tail-wagging dance of bees and "wedding-gifts" of some insects as examples. With such views on symbolicity and arbitrariness of sign systems, Sebeok goes even further than some contemporary authors in biosemiotics.

References

Eco, Umberto
1976 *A Theory of Semiotics. Advances in Semiotics.* Bloomington: Indiana University Press.

Kull, Kalevi (ed.)
2001 *Jakob von Uexküll: A Paradigm for Biology and Semiotics. Semiotica (Special Issue)* 134(1/4).

Kull, Kalevi
2004 Uexküll and the post-modern evolutionism. *Sign Systems Studies* 32(1/2): 99–114.

Sebeok, Thomas A.
1972 Semiotics and ethology. In: Thomas A. Sebeok, *Perspectives in Zoosemiotics.* (Janua Linguarum, Series Minor 122), 122–161. The Hague: Mouton.

Sebeok, Thomas A.
1990 "Animal" in biological and semiotic perspective. In: Thomas A. Sebeok, *Essays in Zoosemiotics.* (Monograph Series of the TSC 5), 115–127. Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto.

Sebeok, Thomas A.
1991a Communication. In: Thomas A. Sebeok, *A Sign Is Just a Sign*, 22–35. Bloomington: Indiana University Press.

Sebeok, Thomas A.
1991b In what sense is language a 'primary modeling system'? In: Thomas A. Sebeok, *A Sign Is Just a Sign*, 49–58. Bloomington: Indiana University Press.

Sebeok, Thomas A. and Marcel Danesi
2000 *The Forms of Meaning: Modeling Systems Theory and Semiotic Analysis.* Berlin: Mouton de Gruyter.

Uexküll, Jakob von
1909 *Umwelt und Innenwelt der Tiere* (Umwelt and Innenwelt in Animals). Berlin: Verlag von Julius Springer.

Uexküll, Jakob von
1920 *Theoretische Biologie* (Theoretical Biology). Berlin: Paetel.

Uexküll, Jakob von
1992 A stroll through the worlds of animals and men: A picture book of invisible worlds. *Semiotica* 89(4), 319–391.

The Theory of Meaning*

Jakob von Uexküll

The Meaning-Carrier

The sight of winged insects, such as bees, bumblebees, and dragonflies, flying about a flower-filled meadow reawakes in us the impression that the whole world lies open for these enviable creatures.

Even earth-bound animals, such as frogs, mice, snails, and worms, appear to move freely in nature.

This impression is deceptive. In truth, every free-moving animal is bound to a specific habitat and it remains the task of the ecologist to investigate its limits.

We do not doubt that a comprehensive world is at hand, spread out before our eyes, from which each animal can carve out its specific habitat. Observation teaches us that each animal moves within its habitat and confronts a number of objects, with which it has a narrower or wider relationship. Because of this state of affairs, each experimental biologist seems to have the task of confronting various animals with the same object, in order to investigate the relationships between the animal and the object. In this procedure, the same object represents a uniform standard measure in every experiment.

American researchers, for example, have attempted indefatigably, in thousands of experiments, starting with white rats, to investigate the relationship of a vast variety of animals to a labyrinth.

The unsatisfactory results of this work, despite the most exact techniques of measurement and their most refined mathematical treatment, could have been predicted, because it was based on the false assumption that an animal can at any time enter into a relationship with a neutral object.

The proof of this seemingly surprising assertion is easy to demonstrate by means of a simple example: Let us suppose that an angry dog barks at me on a country road. In order to drive it off, I pick up a stone and frighten it off with an adept throw. Nobody who observes this process and afterwards picks up the

---

* From: Uexküll, Jakob von 1982. The meaning-carrier. The theory of the composition of nature. The Theory of Meaning. *Semiotica* 42(1): 26–33; 52–59.

stone would doubt that it was the same object, 'stone', which first lay on the road and then was thrown at the dog.

Neither the shape, nor the weight, nor the other physical and chemical properties of the stone have altered. Its color, its hardness, and its crystal formation have remained the same and yet, a fundamental transformation has taken place: It has changed its meaning.

As long as the stone was incorporated in the country road, it served as a support for the walker's feet. Its meaning in that context lay in its playing a part in the performance of the path, we might say that it had acquired a 'path-quality' (*Weg-Ton*).

This changed fundamentally when I picked up the stone to throw it at the dog. The stone became a missile—a new meaning became imprinted upon it. It had acquired a 'throw-quality' (*Wurf-Ton*).

The stone lies in the objective observer's hand as a neutral object, but it is transformed into a meaning-carrier as soon as it enters into a relationship with a subject. Because no animal ever plays the role of an observer, one may assert that they never enter into relationships with neutral objects. Through every relationship the neutral object is transformed into a meaning-carrier, the meaning of which is imprinted upon it by a subject.

The influence that the transformation of meaning exercises on the properties of the object is clarified by two further examples. I take a domed glass dish, which can serve as a neutral object because it has not performed any previous function for human beings. I insert the glass dish into the outside wall of my house and transform it in this way into a window that lets in the sunlight; but, because it also reflects light, it screens out the glances of the passers-by. However, I can also place the glass dish on a table, fill it with water, and use it as a flower-vase.

The properties of this neutral object are not altered at all during these transformations. But as soon as the glass dish has been transformed into a meaning-carrier, 'window' or 'vase', its various properties acquire a rank-order of importance. The transparency of the glass is a 'key' property of the window, while its curvature represents a subsidiary property. In the case of the vase, the obverse is true: The curvature is the key property and the transparency the subsidiary property.

Through this example, we can understand why the scholastics divided the properties of objects into 'essentia' and 'accidentia'. In so doing they had only meaning-carriers in mind; because the properties of neutral objects are not meaning-carriers, they cannot be rank-ordered by importance. Only the tighter or the looser bond between the meaning-carrier and the subject makes possible the separation of the properties into key (essential = 'essentia') and subsidiary (inessential = 'accidentia') ones.

A neutral object consisting of two long poles and several short poles, which are connected to the two long poles at regular intervals, may serve as a third example. If I lean the long poles against a wall, the object acquires a 'ladder-quality' (*Leiter-Ton*). However, I can give it the performance-quality of a fence if I fix one of the long poles horizontally to the ground.

It soon becomes apparent that, in the case of the fence, the cross-poles play a subordinate role. In the case of the ladder, however, they must be distanced at regular intervals so as to make steps possible. A simple spatial construction-plan is, therefore, already apparent in the meaning-carrier, 'ladder', which makes the performance of step-climbing possible.

It is inaccurate to refer to all the uses to which objects are put (although they are, each and all, human meaning-carriers) as if they were neutral, devoid of quality (*Ton*). We even regard a house, with all the things contained in it, as if it existed 'objectively' as a neutral object, in that we totally disregard the people who occupy the house and use the things in it.

That this view is wrong is demonstrated immediately if we replace the human being with a dog as occupant of the house and envisage its relationships to the things in it.

We know from Sarris's[1] experiments that a dog trained to the command 'chair' learns to sit on a chair, and will be on the look-out for other seating-accommodations if the chair is removed; indeed, he searches for canine sitting-accommodations, which need in no way be suitable for human use.

The various sitting-accommodations all have the same 'sitting-quality' (*Sitz-Ton*); they are meaning-carriers for sitting because they can be exchanged with each other at will, and the dog will make use of them indiscriminately upon hearing the command 'chair'.

Therefore, if we make the dog a house-occupant, we will be able to establish that many things will have a 'sitting-quality' for the dog. A great number of things will also exist that will have an 'eating-quality' (*Fress-Ton*) or a 'drinking-quality' (*Trink-Ton*) for the dog. The staircase certainly has a 'climbing-quality' (*Kletter-Ton*). The majority of the furniture, however, only has an 'obstacle-quality' (*Hindernis-Ton*) for the dog—especially the doors and cupboards, which may contain books or washing. All of the small household effects, such as spoons, forks, matches, etc. do not exist for the dog because they are not meaning-carriers.

---

[1] E. C. Sarris, an assistant of von Uexküll who concerned himself with the behavior and training of dogs (and also with the training of guide dogs) from 1931 onwards.

Without doubt, a description of the house and its contents in terms of the qualities imparted to them by the dog is an insufficient one for the human inhabitant.

Are we not taught by this example that the forest, for instance, which the poets praise as the most beautiful place of sojourn for human beings, is in no way grasped in its full meaning if we relate it only to ourselves?

Before we follow this thought further, a sentence from the Umwelt chapter of Sombart's[2] book *About the Human* may be cited:

> No 'forest' exists as an objectively prescribed environment. There exists only a forester-, hunter-, botanist-, walker-, nature-enthusiast-, wood gatherer-, berry-picker- and a fairytale-forest in which Hansel and Gretel lose their way.

The meaning of the forest is multiplied a thousandfold if its relationships are extended to animals, and not only limited to human beings:

There is, however, no point in becoming intoxicated with the enormous number of Umwelts (subjective universes) that exist in the forest. It is much more instructive to pick out a typical case in order to take a look into the relationship-network of the Umwelts.

Let us consider, for example, the stem of a blooming meadow-flower and ask ourselves which roles are assigned to it in the following four Umwelts:

(1) In the Umwelt of a girl picking flowers, who gathers herself a bunch of colorful flowers that she uses to adorn her bodice;
(2) In the Umwelt of an ant, which uses the regular design of the stem-surface as the ideal path in order to reach its food-area in the flower-petals;
(3) In the Umwelt of a cicada-larva, which bores into the sap-paths of the stem and uses it to extract the sap in order to construct the liquid walls of its airy house;
(4) In the Umwelt of a cow, which grasps the stems and the flowers in order to push them into its wide mouth and utilizes them as fodder.

According to the Umwelt-stage on which it appears, the identical flower stern at times plays the role of an ornament, sometimes the role of a path, sometimes the role of an extraction-point, and finally the role of a morsel of food.

This is very astonishing. The stem itself, as part of a living plant, consists of well-planned interwoven components that represent a better-developed mechanism than any human machine.

The same components that are subjected to a certain building-plan (*Bauplan*) in the flower stem are torn asunder into four different Umwelts and are integrated, with the same certainty, into various new building-plans (*Baupläne*).

---

2. Werner Sombart (1863–1941), German sociologist.

Each component of an organic or inorganic object, on appearing in the role of a meaning-carrier on the life-stage of an animal subject, has been brought into contact with a 'complement', so to speak, in the body of the subject that becomes the meaning-utilizer.

This conclusion draws our attention to an apparent contradiction in the fundamental features of living nature. The fact that the body structure is ordered according to a plan (*Planmässigkeit*) seems to contradict the idea that the Umwelt structure is also ordered according to a plan (*Planmässigkeit*).

One must not be under the illusion that the plan to which the Umwelt structure accords is less systematically complete than the plan according to which the body structure is ordered.

Each Umwelt forms a closed unit in itself, which is governed, in all its parts, by the meaning it has for the subject. According to its meaning for the animal, the stage on which it plays its life-roles (*Lebensbühne*) embraces a wider or narrower space. This space is built up by the animal's sense organs, upon whose powers of resolution will depend the size and number of its localities (*Orte*). The girl's field of vision resembles ours, the cow's field of vision extends away over its grazing-area, while the diameter of the ant's field of vision does not exceed 50 centimeters and the cicada's only a few centimeters.

The localities are distributed differently in each space: The fine pavement the ant feels while crawling up the flower stem does not exist for the girl's hands and certainly not for the cow's mouth.

The structure of the flower stem and its chemistry do not play any part on the stages upon which the girl or the ant play their life-roles. The digestibility of the stem is, however, essential to the cow. The cicada sucks out the sap it needs from the finely-structured sap-paths of the stem. It is even able, as Fabre[3] has shown, to obtain completely harmless sap for its foam-house from the poisonous spurgeplant.

Everything that falls under the spell of an Umwelt (subjective universe) is altered and reshaped until it has become a useful meaning-carrier; otherwise it is totally neglected. In this way the original components are torn apart without any regard to the building-plan that governed them until that moment.

The contents of the meaning-carriers are different in the various Umwelts, although they remain identical in their structures. Part of their properties serve the subject at all times as perceptual cue-carriers, another part as effector cue-carriers.

The color of the blossom serves as an optical perceptual cue in the girl's Umwelt, the ridged surface of the stem as a feeling perceptual cue in the Umwelt

---

[3] Henri Fabre (1829–1915), French insect researcher.

of the ant. The extraction-point presumably makes itself known to the cicada as a smell perceptual cue. And in the cow's Umwelt, the sap from the stem serves as a taste perceptual cue. The effector cues are mostly imprinted upon other properties of the meaning-carrier by the subject: The thinnest point of the stem is torn apart by the girl as she picks the flower. The unevenness of the stem's surface serves the ant both as a touch perceptual cue for its feelers and as an effector cue-carrier for its feet. The suitable extraction-point that is made known by its smell is pierced by the cicada, and the sap that flows out serves as building material for its house of air. The taste perceptual cue of the stem causes the grazing cow to take more and more stems into its chewing mouth.

Because the effector cue that is assigned to the meaning-carrier extinguishes in every case the perceptual cue that caused the operation, each behavior is ended, no matter how varied it may be.

The picking of the flower transforms it into an ornamental object in the girl's world. Walking along the stem changes the stem into a path in the ant's world, and when the cicada-larva pierces the stem, it is transformed into a source for building material. By grazing, the cow transforms the flower stem into wholesome fodder.

Every action, therefore, that consists of perception and operation imprints its meaning on the meaningless object and thereby makes it into a subject-related meaning-carrier in the respective Umwelt (subjective universe).

Because every behavior begins by creating a perceptual cue and ends by printing an effector cue on the same meaning-carrier, one may speak of a functional circle that connects the meaning-carrier with the subject (Figure 1).

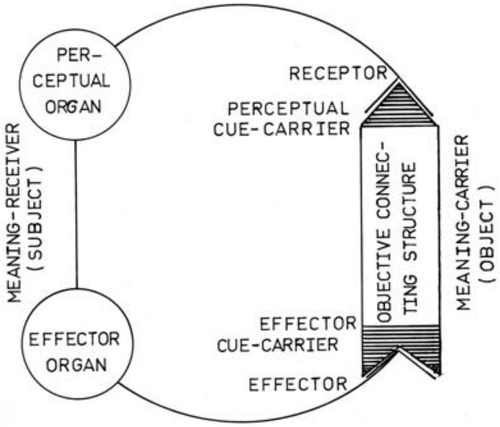


Figure 1. The functional circle.

The most important functional circles found in most Umwelts are the circles of physical medium, food, enemy, and sex.

Due to its integration into a functional circle, every meaning-carrier becomes a complement of the animal subject. In the process, particular properties of the meaning-carrier play a leading role as perceptual cue-carriers or effector cue-carriers; and other properties, on the other hand, play only a subsidiary role. The biggest part of the body of a meaning-carrier frequently serves as an undifferentiated objective connecting structure (*Gegengefüge*) whose function is only to connect the perpetual cue-carrying parts with the effector cue-carrying parts.

The Theory of the Composition of Nature

Nature offers us no theories, so the expression 'a theory of the composition of nature' may be misleading. By such a theory is only meant a generalization of the rules that we believe we have discovered in the study of the composition of nature.

Therefore, it is appropriate to begin with single examples and to set out their rules so as to arrive at a theory of the composition of nature.

The theory of composition of music can serve as a model; it starts from the fact that at least two tones are needed to make harmony. In composing a duet, the two parts that are to blend into harmony must be written note for note and point for point for each other. On this principle the theory of counterpoint in music is based.

We must also look for two factors that form a unit in the examples taken from nature. Therefore we always begin with a subject that finds itself in its Umwelt (subjective universe) and we examine its harmonious relationships with individual objects that have appeared as meaning-carriers to the subject.

The organized body (*Organismus*) of the subject represents the meaning-utilizer or, at least, the meaning-receiver. If these two factors are joined by the same meaning, then they have been jointly composed by nature. The content of the theory of the composition of nature consists of the rules that govern such pairings.

When two living organisms enter a harmonious meaning relationship with each other, we must first decide which one of the two is to be designated as the subject and meaning-utilizer, and which is to be assigned the role of the meaning-carrier. Next we will have to look for their mutual properties that are related in the manner that point and counterpoint are. If, in a given case, we know enough about the functional circles (meaning-circles) that join a subject to its meaning-carrier, then we can look for the counterpoint on the perceptual side as well as on the side of the effector. This search will enable us to determine the special meaning rule that the composition has followed.

To continue with the example of the acorn: I would first like to present a table concerning the composition of the oak tree and one of its meaning-factors, the rain (Table 1).

Table 1.

<table>
<tr><td><i>Foliage of the oak tree:</i></td><td><i>Rain:</i></td></tr>
<tr><td>Meaning-receiver</td><td>Meaning-factor</td></tr>
<tr><td><i>Points:</i></td><td><i>Counterpoints:</i></td></tr>
<tr><td>Roof-tile shaped arrangement of the leaves with gutter</td><td>Raindrops that run down</td></tr>
<tr><td>Rule of the form-development of the oak tree</td><td>Physical rule of raindrop formation</td></tr>
<tr><td colspan="2"><i>Common meaning rule:</i>
Collection and distribution of the fluid to the tips of the roots</td></tr>
</table>

The foliage of the oak tree mechanically affects the distribution of the raindrops. The rule of the formation of raindrops influences the composition of the melody of the living chime of the acorn cells.

We now turn our attention to animals and try to examine the individual meaning-circles: In the circle of the medium we will find relationships that are similar to those that occur between the oak tree and the rain.

Let us take, as the first example, the *octopus*, designated *as the subject* in its relationship to *sea-water as the meaning-carrier*. We will immediately perceive a contrapuntal relationship. The fact that water cannot be compressed is the precondition for the construction of the octopus muscular swim-bag. The pumping movements of the swim-bag have a mechanical effect on the noncompressible water that propels the animal backwards. The rule that governs the properties of sea-water acts upon the composition of the living chime of the cells of protoplasm of the octopus embryo. It shapes the melody of the development of the octopus form to express the properties of sea-water in a counterpoint; first and foremost, an organ is produced whose muscular walls force the water in and out. The rule of meaning that joins point and counterpoint is expressed in the action of swimming.

The same meaning rule in numerous variations governs the development of the living forms of all marine animals: Sometimes they swim forwards, sometimes backwards, sometimes sideways; sometimes they propel themselves with wave-like movements of the tail, sometimes by fins, and sometimes by legs through the water; but the characteristics of the organism bear the same relationship to the properties of the water as point to counterpoint. In each case, the composition that has a common meaning can be proven.

The same applies to all the various circles of the physical medium, whether the animal lives in water, on the land, or in the air. In every case the effector organs for running, jumping, climbing, fluttering, flying, or soaring are formed contrapuntally to the properties of the respective medium. In the case of many insects that live in the water when they are young and in the air when they are older, one can ascertain in the second larval stage how easily the constitution-rule of the new medium causes the initial organs to disappear and new ones to emerge.

Inspection of the relationship between the subject's receptors and the medium teaches the same lesson. A sensory organ formed as a counterpoint is always present when a subject meets an obstacle: In the case of light it is the eye, and of darkness, tactile organs or the ear.

From the very beginning the bat, like the swallow, is equipped with different means to perceive obstacles in its path of flight.

These, you will reply, are nothing but banalities. Certainly they are everyday experiences that can everywhere be seen. But why has one neglected to draw the only possible conclusion from these experiences? Nothing is left to chance in nature. In every instance a very intimate meaning rule joins the animal and its medium; they are united in a duet, in which the two partners' properties are contrapuntally made for each other.

Only extreme disbelievers of meaning as a factor in nature would want to deny that in the functional circle of sex, males and females are made for each other in accordance with meaning. They assert that the love-duet, which is heard throughout the whole living world in thousands of variations, has emerged totally unplanned.

In the case of the love-duet of animals and humans, two equal partners face each other, each of whom exists in its Umwelt as a subject and appears as a meaning-receiver, while the role of the meaning-carrier is assigned to the other.

Both the perceptual and the effector organs of both partners are allied to each other contrapuntally.

The first requirement necessary for a successful composition of nature is that the meaning-carrier stand out distinctly in the Umwelt of the meaning-receiver. The most diverse perceptual cues can be used to attain this goal.

Fabre reports that the female emperor moth makes pumping movements with its hindquarters in order to press its scent glands to the ground. The scent that rises up from the ground is so potent in the male moth's Umwelt that they are attracted to the scented spot from all sides, and are not distracted by any other smells, all of which sink beneath their perceptual threshold. The attraction of this smell is so strong that when a female is placed in a glass case in the path of the males to make her visible but odorless, they are not distracted from their efforts to reach the scented ground: the meaning-carrier.

Unfortunately, the same experiment has not been tried with a bitch in heat. Possibly male dogs behave exactly like male moths.

In a very interesting case reported by Wunder,[4] the sexual partner does not necessarily serve as the primary meaning-carrier: A second meaning-carrier may be interposed in a sex-circle.

The male bitterling, a small fresh-water fish, puts on a luminous wedding dress at mating time. The sight of a pond-mussel, not the sight of the female fish, causes this to occur; specifically, the male feels the water with which the mussel breathes streaming into and out of the mollusk.

The female also reacts to this stimulus by extending its long ovipositor outwards. While the male discharges its sperm into the water, the female attaches the impregnated egg to the mussel's gills. The young larva can grow there protected from all dangers, in the middle of the stream created by the mussel, which provides the larva with all the requisite nourishment. The meaning of the male's 'wedding dress' is not, of course, related to the mussel, but rather it serves to frighten off other male bitterlings.

These examples serve to illustrate that the meaning-carrier does not alter at all, but nevertheless is treated differently: Its perception by the subject has changed meaning. Meaning is the key by which the compositions of sex in nature are unlocked so that they can be understood.

Fabre tells us in his report on the brown ground-beetle that the males and females pair off after first hunting together. After mating, the male's behavior toward the female does not change at all. The female, on the other hand, throws herself upon her mate and ravenously tears him apart with hardly a struggle. In the Umwelt of the female the meaning-carrier 'friend' has changed into the meaning-carrier 'food' although the structure of the meaning-carrier has not changed in the slightest. In the same way, the paving-stone, without altering its structure, gives up its meaning as an element of a path when it is transformed into a projectile as the mood of the human subject changes. Thereupon the human imprints a different meaning on the stone.

---

[4] W. Wunder (born 1898), zoologist, specialist in fish-breeding and bond ecology.

The imprinting of meaning also explains the puzzling behavior of the young gray-geese that Lorenz[5] reports on. According to him, the gray-goose chick identifies and follows constantly the first living being that it sees after hatching; this becomes its mother-companion.

Even a human being can acquire the meaning of 'mother' for the graygoose. 'What does the human being who becomes identified as the mother-companion look like in the eyes of the gray-goose?' is the question that preoccupied Lorenz.

We should not forget that in the Umwelt of our puppy we do not appear as a 'mother' but as the meaning-carrier 'milk-bringer'; we are sucked at by the puppy without our having assumed the form of a dog.

Von Korff (1938) reports that an eagle-owl had hatched two duck eggs. It treated the ducklings as young eagle-owls, tried unsuccessfully to feed them raw meat, and watched over them during the day while perched on a branch above the duckpond. In the evenings, it returned to its cage with them. When other young ducklings tried to join them, the eagle-owl immediately killed and ate them, although they only differed from the young foster-ducklings by virtue of the meaning conferred upon them by the eagle-owl. While all the other ducklings appeared in the eagle-owl's Umwelt as the meaning-carrier 'prey', the two ducklings hatched by the eagle-owl played the role of eagle-owl chicks.

Because individuals of the same species are usually involved in the sex- and child-circles, the range of the meaning rule, which spans the distance between meaning-carrier and meaning-receiver, is small. However, inspection of the functional circles of enemy and food shows us that their range knows no limits, and that the properties of the remotest objects can be contrapuntally connected.

I have already discussed the bridging of the constitution rule of the bat and the constitution rule of the night moth by the meaning rule.

On one side stands the bat as meaning-carrier, producing only one tone, and on the other side stands the night moth, which can receive only one tone because of its very specialized hearing organ. In both animals this tone is identical. The meaning rule that has created this coordination consists of the relationship between the enemy's attack and its being warded off by the prey.

The tone exists as a sign by which bats recognize each other, while it also serves as a signal for the night moth to escape. In the bat's Umwelt it is a 'friend-tone' and in the night moth's Umwelt, an 'enemy-tone'. According to its different meanings, the same tone creates two completely different hearing organs.

---

[5] Konrad Lorenz (born 1903), zoologist and animal psychologist, honored with the Nobel Prize for his research in ethology.

Because the bat is able to hear many tones, its ear is adapted to resonate broadly. However, it can only emit this one tone.

It would be equally interesting to trace the bridge formed between the tick and the mammal by the use of the meaning rule (as shown in Table 2). The tick sits motionless on the tip of a branch until a mammal passes below it. The smell of the butyric acid awakens it and it lets itself fall. It lands on the coat of its prey, through which it burrows to reach and pierce the warm skin with its sting. It then pumps the liquid blood into itself; it does not possess an organ of taste.

The pursuit of this simple meaning rule constitutes almost the whole of the tick's life.

Table 2.

Tick:	*Any mammal:*
Meaning-receiver	Meaning-carrier
Points:	*Counterpoints:*
1. The organ of smell is adapted for one smell, namely, butyric acid.	1. The only smell common to all mammals is the butyric acid found in their sweat.
2. A tactile organ is present, ensuring that the tick can exit from the hairs of its prey.	2. All mammals have hair.
3. A thermal organ senses a perceptual sign for warmth.	3. All mammals possess a warm skin.
4. The tick's stinger is suitable for boring into the skin of each mammal, and at the same time serves as a fluid pump.	4. All mammals possess soft skin well-supplied with blood.

Common meaning rule:

Recognition and attack of the prey and extraction of blood on the part of the tick.

The deaf and blind tick is solely constituted to make every mammal in its Umwelt appear as the same meaning-carrier. This meaning-carrier can be described as an extremely simple mammal without the visible or audible properties that usually differentiate the various species of mammals. For the tick, the meaning-carrier has only one smell, which comes from the sweat common to all mammals. That meaning-carrier is also tangible and warm, and allows itself to be bored into and to have blood extracted from it. In this way it is possible to reduce all mammals—no matter how greatly they differ in shape, color, sound, and smell in our Umwelt—to a common denominator. On approach, the properties of any mammal—be it a human, a dog, a deer, or a mouse—contrapuntally activate the life-rule of the tick.

In our human Umwelt a mammal does not in itself appear as a vivid object, but as a mental abstraction, a concept to be used to classify, not as an object we ever encounter.

The case of the tick is quite different. A vivid mammal exists in the tick's Umwelt that has a few properties capable of serving as counterpoints and exactly meeting the tick's needs.

If one only searches for mechanical explanations, the fit of the hermit crab in the snail shell must rank as a special enigma. This fitting-in cannot be interpreted as a gradual adaption through any modifications in anatomy.

However, as soon as one gives up such fruitless endeavors and merely ascertains that the hermit crab has developed a tail as a prehensile organ to grasp snail shells, not as a swimming organ, as other long-tailed crabs have, the hermit crab's tail is no more enigmatic than is the rudder-tail of the crayfish.

The prehensile tail is composed as a counterpoint to the snail shell, just as the rudder-tail of the crayfish is to the water.

Hertz (1937, 1939) made the interesting discovery that honey-collecting bees are only able to differentiate between two shapes: open and closed ones. Beam-shapes and polygons of every kind attract the bees, while closed shapes, like circles and squares, repel them. The gestalt-theorists claim that the reason for this is that the open shapes possess a greater stimulus-value. This point can be conceded to them. But what does this idea mean? The answer becomes immediately apparent the moment we say the following: All inaccessible buds, which the bees shun, have closed shapes. Blossoms that offer them their honey have open shapes.

Two spatial-perceptual schemata for blossoms and buds are incorporated into the shape-forming rule of bees because the collection of honey follows the meaning rule. In this manner, the two schemata are firmly joined in counterpoint with the two principal shapes of flowers.

But how does nature manage when an animal subject depends on differentiating between shapes but possesses a very primitive central nervous system incapable of forming shape-schemata?

The earthworm pulls linden or cherry tree leaves into its narrow hole. The leaves simultaneously serve as food and protection. It grasps the leaves by their tips in order to roll them up easily. If the earthworm were to try to grasp the leaves at their base, they would resist being pulled and rolled. However, the earthworm's structure does not permit the formation of shape-schemata; to compensate for this deficit it possesses a particularly fine sense organ for taste.

We owe to Mangold[6] the discovery that the earthworm can nevertheless distinguish between the pieces that belong to the bases and those that belong to the tips of finely-chopped leaves. The tips of the leaves do not taste the same to the earthworm as do their bases: This distinction allows the worms to treat them separately. Taste perceptual cues, acting as counterpoints, take the place of shape-schemata to make it possible for the earthworms to pull in the leaves, an action that is essential for the survival of the earthworms.

In this example one can speak of nature's refined composition.

Experience has taught human anglers that, when angling for fish of prey, they do not need to affix an exact likeness of the prey to the hook. Rather it is enough to offer the pike as bait a simple little silver plate that is a very general facsimile of a whitebait.

Nature, however, does not need to be taught this lesson. *Lophius piscatorius*, the angler-fish, is a wide-mouthed fish, next to whose upper lip is a long movable bone that causes a silver band to flutter.

This band attracts smaller fish of prey that, on snapping at this bait, are sucked into the wide mouth that suddenly produces a whirlpool.

The range of the meaning rule is further extended by this example, because it does not connect the form-shaping rule of *Lophius* with its prey's form-shaping rule. The victims are themselves predators who respond to a very simplified image (presented by *Lophius*) of their own prey in their Umwelt and are caught.

A similar example occurs in the case of those butterflies that are decorated with spots resembling eyes. By opening their wings they chase away the small birds that pursue them: These birds automatically fly away at the sight of the eyes of other small predators that may suddenly appear.

In the same way *Lophius* is unaware how the prey it catches looks in the Umwelt of the fish of prey, the butterfly does not know that the sparrow flees at the sight of a cat's eyes. However, the composer of these Umwelt-compositions must be aware of this fact.

This is no human knowledge that can be obtained through experience. The tunnel-boring actions of pea-beetle larvae prove to us that they are conditioned by a transsensual knowledge that is timeless. Thanks to this knowledge, the composer can shape the future life-requirements of an unborn beetle and program the actions of the beetle larva.

---

[6] Otto August Mangold (born 1891), zoologist, student of Spemann, since 1946 head of the department in Heiligenberg (Max Planck-Institut). He has been occupied, among other things, with embryonal cells.

References

Hertz, Mathilde
1937 Beitrang zum Farbsinn und Formsinn der Biene. *Zeitschrift für vergleichende Physiologie* 24, 413–421.

Hertz, Mathilde
1939 New experiments on colour vision in bees. *Journal of Experimental Biology* 16(1), 1–8.

Von Korff, F.
1938 Uhu als Pflegemutter von Entenküken. *Ornithologische Monatsberichte* 46, 121.

Zoosemiotics: At the Intersection of Nature and Culture*

Thomas A. Sebeok

When, at the end of the 17th century, John Locke injected a Hellenic variant of the term *semiotics* into English philosophical discourse, reshaping and expanding the field as the 'doctrine of signs' (for he adapted *séméiotikè* from a context where it meant merely the art of musical notation), he characterized it as that branch of his tripartite division of the sciences "the business whereof is to consider the nature of signs the mind makes use of for the understanding of things, or conveying its knowledge to others." While his prime concern was with those signs of our ideas "which men have found most convenient, and therefore generally make use of," that is, "articulate sounds" or verbal signs, Locke was fully aware that other creatures, such as birds, also have perception, "retain ideas in their memories, and use them for patterns," in brief, that they are comparably served by signs. That giant among philosophers, the American C. S. Peirce, convinced that many passages in Locke's 1690 *Essay* "make the first steps in profound analyses which are not further developed," took the term with his definition over from him, then devoted a lifelong study to "the doctrine of the essential nature and fundamental varieties of possible semiosis," contending that "the entire universe is perfused with signs, if it is not composed exclusively of signs." Consistently, Peirce refused to draw a sharp distinction between animal and human sign-process. His heir, Charles Morris, cast his net equally widely. However, neither Peirce nor Morris was equipped to carry out detailed investigations of animal communication or signification, although both of their intellectual armatures not merely allowed for but actually seemed to invite applications in those domains. Eventually, a succession of animal behaviorists found Morris's model and terminology at least of heuristic value: incidental works of R. M. Yerkes and H. W. Nissen (1939), P. Marler (1961),

---

* From: Sebeok, Thomas A. 1990. Zoosemiotics: At the intersection of nature and culture. In: Thomas A. Sebeok. *Essays in Zoosemiotics* (Monograph Series of the TSC 5), 37–47. Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto. Reproduced with permission of Toronto Semiotic Circle.

S. A. Altmann (1967), and W. J. Smith (1968, *et seq.*) constitute a scattering of outstanding examples of zoological attempts to gain some special insight into the vocalizations of a chimpanzee or that of chaffinches, or to clarify outstanding theoretical concerns within a recognized semiotic framework.

In an independent but parallel tradition, amplified by F. de Saussure's heritage, semiotics, alias *sémiologie*, has remained steadfastly anthropocentric, intertwined with language, *le patron général* of Saussure's programmatic science. Many linguists later tended to more or less agree: thus L. Bloomfield asserted that "Linguistics is the chief contributor to semiotic," and U. Weinreich called natural languages "the semiotic phenomenon par excellence." But it was the prominent French critic Roland Barthes who—like W. H. Auden's "linguist who is never at home in Nature's grammar"—carried this glottocentricity to its preposterous (but perhaps playfully conceived) conclusion by turning Saussure's formulation topsy-turvy with his declaration that "linguistics is not a part of the general science of signs, even a privileged part, it is semiology which is a part of linguistics…" The validity of this paradoxical inversion of the customary order of things can be contemplated only, if at all, at the price of throwing all of comparative semiotics overboard by dividing the animate world into two unequal classes—speechless vs. language-endowed—and then consigning the sign behavior of well over two million extant species of animals beyond the semiotic pale. Yet such is the practical focus of most of Gallic-oriented semiotic preoccupation. To be sure, there are certain noteworthy exception, such as the bioacoustic researches of R.-G. Busnel, the information theoretical writing of the polymath A. Moles, and especially the inspired work of Paul Bouissac, a rare specialist in the semiotic aspect of spectacles—though hardly a prophet in his own country of France ("parce que ce n'est pas sérieux," as a fountainhead of *Tel Quel* once confided to me)—whose subtle and knowing preoccupation with animal acts in circuses (e.g. bears, the big cats, horses) has, in important respects, converged with the surpassing scientific observations carried on, since 1935, by the farsighted Swiss comparative psychologist, H. Hediger. As for the best Soviet scholarship, this, too, has hitherto chiefly focused on the fruitful concept of secondary modeling systems, or macrosemiotic structures, which, by definition, imply a linguistic infrastructure; yet N. Žinkin has cast his studies on communication in baboons in an explicit semiotic setting, V. V. Ivanov is known to share Eisenstein's predilection for circus acts, and leaders of a recently formed team of young biologists in Moscow have privately avowed their semiotic perspective to henceforth guide their investigations of fundamental problems of animal communication.

While generations of philosophers and some linguists were prefiguring a shadowy science of signs (of which Saussure reportedly remarked, "Puisqu'elle n'existe pas encore, on ne peut dire ce qu'elle sera…"), seldom paying more than perfunctory heed to sign-systems other than man's species-specific codes, an entirely different breed of scholars was at work developing, or, rather, redirecting, *ethology*, focusing it upon certain processes and the progress of mental evolution, largely on the basis of naturalistic observations. Although ethology (a term than can be traced back, with something like its present connotations, to the brilliant early 19th century evolutionist Étienne Geoffroy-Saint-Hilaire, and his son, Isidore) is perhaps nowadays most comprehensively yet simply defined as the biological study of behavior, a careful analysis of the literature since Darwin—especially beginning with *The Descent of Man* (1871), with its emphasis on displays and other sign stimuli—fully supports the remarks of a prominent specialist in arthropods, R. D. Alexander, that "data on animal communication have contributed a thread of continuity that … has seemed to be the principal axis of synthesis in the entire field of animal behavior."

The semiotic concerns of ethology have crystallized around the principle of *ritualization*, a term coined by Julian Huxley, in 1914, to explain how the so-called penguin dance, climaxing the courtship ceremony of great crested grebes, has evolved from a simple locomotory movement by which this bird approaches the edge of its nest; or, interpreted more generally, how a minimally ambiguous sign function is elaborated from movements that are initially devoid of discernible semiotic motivation. This very fertile ethological concept has already opened up vast perspectives for a diachronic semiotics, but its potential implications for the phylogenetic analysis of the components of human communication have as yet barely been touched upon, e.g., by R. J. Andrew, Ian Vine, and others in England, by J. A. R. A. von Hooff in the Netherlands, in I. Eibl-Eibesfeldt's capital 'human ethology' workshop in Bavaria, or in the course of a disappointingly inconclusive multidisciplinary conference of the Royal Society, voluminous transactions of which were published seven years ago.

Those biologists who, somewhat in the manner of M. Jourdain, have pursued their semiotic inquiries, "il y a plus de quarante ans," without being aware of so doing, had the connection first made explicit in 1963, summed up by yet another coinage, *zoosemiotics*, intended as a mediating concept for reconciling these two seemingly antithetical spheres of discourse, ethology and semiotics: the former, anchored in the realm of Nature, embracing the totality of the multifarious phenomena of animal behavior on the one hand, the second, rooted in the matrix of Culture, traditionally held by many to comprise exclusively man's signifying competence on the other. This new formation was evidently welcome, for it not only diffused with great rapidity through appropriate scientific writing, but also, more astonishingly, cropped up in a 1965 novel by Pamela

Hansford Johnson, not to mention a cartoon, co-featuring Snoopy, in a March 1973 issue of the Milanese *Corriere della Sera.* At any rate, in the 1970s, it no longer seems strange to find the director of a major European zoo insisting that theoretical questions of animal communication be resolved "unter dem Gesichtspunkt moderner Kommunikationslehren, besonders auch der Semiotik…"

Ethologists refer to the behavioral dossier of species as its *ethogram*, and, like N. Tinbergen, would place a special emphasis on the importance of amassing a complete inventory of patterns for each. In semiotic terms, this concept encompasses an animal's species-specific communicative code, in confrontation with which the human observer's role necessarily becomes that of a cryptanalyst, of someone who receives messages not destined for him and is initially ignorant of the applicable transformation rules. The code underlying any system of animal communication differs crucially from any language in so far as the former is simply tantamount to the total repertoire of messages at the disposal of the species, whereas a true language is always imbued by the structural principle that linguists have called 'double articulation' or 'duality of patterning,' involving a rule governed device for constructing a potentially infinite array of larger units (e.g. sentences, in the so-called natural languages) out of a finite, indeed, very small and stable assembly of smaller ones (viz., the uniformly binary distinctive features). This enormously powerful and productive hierarchic arrangement—obviously recognized by Darwin in his keen observation that "The lower animals differ from man solely in his almost infinitely larger power of associating together the most diversified sound and ideas…"—seems to have emerged but twice in terrestrial evolution, both times with stupendous consequences: the same structural principle informs the genetic code (the Beadles' 'language of life') and the verbal code (our own faculty of language). It has, however, so far, not been identified in any other animal communication system studied (including, incidentally, that of captive chimpanzees in the Western United States, who have recently enjoyed publicity of the sort previously accorded only to bottle-nosed dolphins, those fading stars of fact and fiction of yesteryear). It is therefore scientifically inaccurate, as well as, even metaphorically, highly misleading to speak of a 'language' of animals.

As for the pious goal of a perfect ethogram, unfortunately this still remains just that, for, despite the fact that the literature of animal behavior is now enormous, and still rapidly ramifying, none of the several millions of codes still in use is entirely understood by man. This is true even of the best researched code, namely, the one that regulates the remarkable communication system evolved in *Apis mellifera*, the honeybee. While the fact that these bees perform intricate movements—their famous 'dances'—in directing hive-mates to a source of food supply, or to new quarters, has been widely reported and is now a familiar story, it is less well known that these insects transmit information by acoustic means as well. Investigators in several laboratories, working independently of one another, have been attempting to complete an account of this facet of the apiarian ethogram, in spite of the prejudgment of some major scholar that the ancient ideas of acoustic communication among the bees "belong in the realm of fantasy." Communication by sound does occur in bees, and is probably even more elaborate and significant than has been anticipated. As K. von Frisch himself once remarked, "the life of bees is like a magic well. The more you draw from it, the more there is to draw." The same is undoubtedly true of the life of all the other speechless creatures, while our knowledge of their communicative capacities and means remains even more rudimentary.

The word *display* is another commonplace in the vocabulary of ethology, as featured, for instance, in the title of E. A. Armstrong's erudite conspectus, *Bird Display* (1942; in later editions, expanded to *Bird Display and Behaviour*). Thus a rhesus monkey's simple stare is considered a low-intensity display of hostility. This term, however, remains a seldom defined or refined zoosemiotic prime, vaguely understood by everyone to refer to such behavior patterns, of sometimes bizarre complexity, that are deemed by an expert observer to have a predominantly communicative function: indisputably, for instance, the intricate courtship activities of bower-birds, that use 'display-objects' of certain specified color combinations which they have collected with great discrimination to decorate their avenue- or maypole-type houses and ornamented gardens with, substituting, as it were, glittering natural jewelry for drab plumage, are likewise characterized as displays. In brief, the ethologist's 'display' is synonymous, or substantially overlaps, with the semiotician's master concept, the 'sign,' whether simple or compound, which, by all accounts—from the Stoic distinction of *sēmainon vs. sēmainomenon* to multiform recent and contemporary formulations—is conceived of as a bifacial construct, i.e. as constituted of two indispensable moities: the *signifier*, an appreciable impact on at least one of the interpreter's sense organs, and the content *signified*. 'Sign,' however, is a generic term: recognition of the manifold potential relations between the two parts of the sign, what Peirce has called the "fundamental varieties of possible semiosis," has led to the realization of many different sign processes. Peirce himself, in his memorable 1866 paper in *The Journal of Speculative Philosophy*, introduced three, but, by the end of the century, his initial trichotomy yielded ten classes of signs, which later grew into sixty-six, including intermediate and hybrid forms, and what he called 'degenerate' signs.

A fair sample of the most commonly acknowledged and utilized signs—notably including signal, symptom and syndrome, icon, index, symbol, and name—were subjected to detailed scrutiny, particularly in the light of recently accumulated data on non-verbal communication, with the unexpected result that every type of sign thus analyzed has been found to occur in the animal kingdom as well as in human affairs, so that it is feasible now to separate, say, an iconic display from an indexic display or a symbolic display, or to comprehend thoroughly what is meant by the assertion that vertebrates seem universally to incorporate their own 'names' into all of their messages. The rather imprecise ethological notion of *imprinting* refers to a learning process responsible for restricting the filial behavior of young vertebrates, and hinges on a decisive early sensitivity to a conspicuous, familiar object, in short, a sign, the nature of which can now also be specified. The fondly cherished mythic characterization of man, adhered to by E. Cassirer's epigones and many others, as a unique *animal symbolicum* can be sustained only if the definition of 'symbol' is impermissibly ensnared with the concept of natural language, which G. G. Simpson quite aptly characterized as "the most diagnostic single trait of man." By every other definition—invoking the principe of arbitrariness, the idea of a conventional link between a signifier and its denotata, Peirce's 'imputed character,' or the notion of an intentional class for the designatum—animals demonstrably employ symbols. Space limitations permit only two brief examples here, both deliberately chosen from the world of insects: in a species of dipterans of the carnivorous family *Empididae*, the male offers the female an empty balloon prior to copulation. The evolutionary origins, that is, the increasing ritualization, of this gesture have been unravelled, step by step, by biologists, but this story is irrelevant in a synchronic perspective: the fact remains that the gift of the balloon features a wholly arbitrary symbol, the transfer of which merely reduces the probability that the male himself will fall prey to his female partner. For the second example, consider again the honeybee. It is common knowledge that if its food source is farther away than 100 m., the bee's tail-wagging dance conveys, among other bits of information, the direction of the goal, the sun being used as a reference point. Now if the bee dances on a horizontal surface, von Frisch teils us that "the direction of a waggling run points directly to the goal," that is to say the display is indexic (the rhythm, incidentally, depicts the distance iconically, since the farther away the goal, the fewer cycles of the dance occur in a given period). If, however, the dance takes place on a vertical comb surface—as is the case, normally, in the dark hive—then "the dancer transposes the solar angle into the gravitation angle," according to von Frisch. In other words, if a vertical honeycomb is involved, when an angle with respect to gravity is substituted as the orientation cue, the indexical aspect of the display attenuates to the extent that, temporarily, its symbolic aspect comes to rank predominant.

The essential unity of a zoosemiotic event may be decomposed, for the field observer's or laboratory experimenter's convenience, into six aspects, and the sphere of animal communication studies has, in practice, tended to divide roughly in accordance with these, the factors actually emphasized depending on each investigator's training and bias. Two of these factors—code and message—I have already mentioned; their study belongs to zoosyntactics, which deals with combinations of signs abstracted from their specific signification or their ecological setting. Zoosemantics is devoted to the signification of signs, and must take account of the context referred to by the source and apprehensible by the destination; this is the least well understood dimension of animal communication studies.

Zoopragmatics may be said to deal with the origin of signs in the source, or sender, the propagation of signs through a medium, or channel, and the effect of signs on the destination, or receiver. Contact among emitters and receiver of messages is established and maintained by an impressive variety of flow processes that link them across space and time. In principle, of course, any form of energy propagation or transfer of matter can serve as a sign vehicle, depending on an animal's total perceptual equipment. In part because of their immediate appeal to the imagination of men, and in part stimulated by technological refinements of the last three decades, the study of mechanical vibrations by which some species communicate—the field of bio-acoustics, operating across the medium of air, under water, or even through solids—constitutes one of the most advanced branches of zoosemiotics. Classical ethology was more concerned with optical systems, on the basis of which it was able to generalize such more or less fruitful concepts as the 'intention' and 'displacement' movements, and that of 'autonomic effects'; and invertebrate zoology concentrated primarily on the transfer of information by relatively stereotyped chemical substances (pheromones). One of the most fascinating channels to 'open up' lately gives access to a busy world of electrocommunication, where several kinds of discharge alterations have now been clearly shown to correlate with social situations, having to do with food, threat, attack, submission, mating, and the like, in a high number of electroreceptive species of fish surveyed. If an animal's sensory capacity allows for the parallel processing of information through multiple input channels, as is the case in monkeys and apes, whose communication, Thelma Rowell recently reminded us, "is usually carried on through several modalities at the same time," calculable redundancies will be found to prevail, so that the discovery of the rules for switching from one subassembly to another should, in principle, be determinable. Such an integrated description is, unfortunately, very rarely given in animal communication studies, yet not surprisingly so, since a fully coordinated account of our verbal with our non-verbal processes is also sadly lacking: as for Hamlet's players, discretion must, therefore, still be our tutor when we "suit the action to the word, the word to the action."

Animal emitters and interpreters of strings of signs are either conspecifics or they belong to two or more species, one of which may be man. Many zoologists, like V. C. Wynne-Edwards, tend to divide interindividual sign repertoires first of all into intraspecific vs. interspecific varieties, but it is fair to say that explorations of the former, where all messages are assumed to be mapped onto a singly code, have progressed much further than those concerned with situations requiring at least a partial sharing of and switching among several codes. Mimicry, as distinguished from mere imitation—for instance, of an infant macaque of its mother—almost always requires at least two species of animals or plants (or an inorganic surrogate) for its realization, as W. Wickler has shown in his handsome introduction to the subject; in its so-called Müllerian manifestation, it is exemplified by the series of black longitudinal stripes exhibited by different species of cleaner fish that wear this uniform identification pattern, or badge, allowing them all to communicate with certain larger predators by way of this common convergence feature. Even tourists on an African safari have now learned to appreciate the palpable sharing of, say, signs of alarm by representatives of mixed game visiting at the same waterhole. Moreover, subtle semiotic ecosystems are sometimes formed not only by several interdependent animal species, but also in conjunction with plants, as in the complex community achieved by a group of insects (the *Danaidae*) and blue jays together with milkweeds belonging to the family of *Asclepiadiceae.*

How man communicates with animals, and vice versa, has, so far, been of marginal concern to both semiotics and ethology (although it is an insistent theme in the pioneering works of Professor Hediger, and K. and M. Breland's excellent little book on *Animal Behavior*, written with an engineering objective in view). Yet in all arenas of life the relation between man and animal—from protozoan to primate—is now decisive. Wherever they meet, whether man is an animal's scourge or its prey (e.g., of his still biggest killer, the mosquito); whether one is a parasite of the other (as F.E. Zeuner characterized man's relationship vis-à-vis the reindeer); or whether one species accepts the other as a conspecific (witness London's late panda, which was alleged to have been imprinted upon its keeper), or, to the contrary, as an inanimate object (e.g. man as a part of a vehicle in a wild-life park), the liaison implies that each must, perforce, learn, if not totally master, the essential elements of the reciprocal's code. After establishing loose contacts with an animal, man, if he so wills it, can follow up by taming it, a process that can be defined as a systematic reduction of flight distance achieved by conscious manipulation of the animal's code. A tame animal can then be subjected to the purely synchronic process of training, and that in one of two complementary ways: *apprentissage* or *dressage*, i.e. for scientific testing or for performing in exhibitions, the two being polar opposites—as E. Kuckuk already emphasized in his 1936 disquisition on a couple of young brown bears: "Die Zirkusdressur ist … das genaue Gegenteil eines tierpsychologischen Versuchs." The two procedures are distinguishable in at least two respects: the semiotic character of the sign which initiates the requisite action (unmarked vs. marked), and the degree of emotional intensity coupling the interactants (minimal vs. maximal). Next, if economic circumstances dictate the planned development of form with certain properties man deems desirable, he superposes a diachronic dimension: by selective breeding, or alteration of the genetic code, domestication (with flight distance approaching constant zero) will ensue. The final, alas irreversible, step may be the cutting off of all further communication with members of the species—the persecution, then eventual extermination, of its feral ancestors.

It is important to appreciate in detail how the proper methods of semiotic analysis can illuminate the judgment of all ethological observations and experiments—lacking which, one need only recall that classic scandal of scientific obfuscation, known as the 'Clever Hans' episode, that hinged on the trainer's self-delusion about the steady stream of indexic signals, reduced to mere synecdoches scarcely perceptible even to the acutest witnesses, that he unwittingly broadcast to his horse, but which the animal was able to interpret swiftly and surely; and even today, one must vigilantly be on guard to prevent the transmogrification of clever horses (Hans was by no means the only one) into cleverer chimpanzees! Our relationships with animals in game preserves or zoological gardens, in the intimacy of the circus, and comparable marine installations, or biological research laboratories, on the farmstead or in the home, could be materially enhanced by realizing exactly how, in all such dyadic contacts, paired systems of communication, which influence one another in exceedingly intricate ways, are juxtaposed in constant interplay.

While semiotics, at least in the vital Locke-Peirce-Morris tradition, continues to widen its horizons to comprehend the entire animal kingdom, indeed, the whole of organic existence (hence G. Tembrock's preference for a broader label, *biosemiotics*), as well as the sign functions of machines (so S. Gorn speaks of the fundamental semiotic concepts of computers), ethology is likewise moving to enlarge its scope to embrace man (a facilitative step in this direction was the recent creation of a semi-independent research group for human ethology, under the prestigious auspices of the Max Planck Institute of Behavioral Physiology, and one must also single out the work of N. Blurton Jones with young children in England). By systematic application of the principles of ritualization and its corollaries to aspects of non-verbal behavior, over an impressively world-wide data base, much of it freshly collected and preserved on film, some salient facts have already been established, pertaining, for example, to the universality of certain human facial expressions and gestures previously considered culture-bound. Ethology has, of course, failed to shed any light on the evolution of man's unique faculty of language, despite Huxley's truism that it, too, is "ritualized (adaptively formalized) behaviour": ritualization works on the assumption that behavior unfold with morphological growth and differentiation, but how can one apply the comparative method to a sample of one? The outlines of a semiotics that eschews anthropocentrism, coupled with an ethology that shuns parochialism, can already be envisaged. It seems likely that a full-fledged synthesis will be achieved before long, offering both a new paradigm and a methodology for the comparative analysis of semiosis in its full diversity, ranging from the two vast linked polymer languages at one end of the scale to the thousands of natural languages at the other, with a host of singular information coding and transmission devices, inside and outside the body of every organism, in between. Semiosis, independent of form or substance, is thus seen as a universal, criterial property of animate existence.

“Talking” with Animals: Zoosemiotics Explained*

Thomas A. Sebeok

Semiotics is, quite simply, the exchange of messages. A message consists of a sign or a string of signs. “Zoosemiotics” is a term coined in 1963 to delimit that segment of the field which focuses on messages given off and received by animals, including important components of human nonverbal communication, but excluding man’s language and his secondary, language-derived semiotic systems, such as sign language or Morse code.

Biologists define life as a system capable of evolution by natural selection. This genetic definition, which places great emphasis on the importance of replication, is entirely compatible with the modern semiotic point of view, which asserts that all communication is a manifestation of life, and that it is the capacity to communicate that distinguishes living being from inanimate substances. Reproduction is itself a matter of communication, the molecular code being one of the two master sign-systems on earth. The other one is the verbal code—our language. The molecular code is apparently the same in all terrestrial organisms; the verbal code is fundamentally the same—with superficial variations—in all the peoples of the globe.

Scholars distinguish two varieties of animal communication: intraspecific and interspecific. Intraspecific communication refers to all of those devices at the disposal of an animal that link it to every other member of its own species, and all others to it. Territory delineation, and the location of kin, competitors, and prospective mates, are among these devices. Examples of intraspecific messages are the bright flashes of light used in the dialogue among fireflies, and exchange of coded information about species identity, sex and location. The flash code used varies from species to species within the family of beetles to which fireflies belong. Certain fishes communicate with their own kind by broadcasting different patterns of electric pulses to threaten, indicate submission, carry on courtship, or even, by discharging a particular set of signs, to insure indi-

---

* From: Sebeok, Thomas A. 1990. ‘Talking’ with animals: Zoosemiotics explained. In: Thomas A. Sebeok. *Essays in Zoosemiotics* (Monograph Series of the TSC 5), 105–113. Toronto: Toronto Semiotic Circle; Victoria College in the University of Toronto. Reproduced with permission of Toronto Semiotic Circle.

vidual recognition from a mate, a companion or rival, and thus to help promote cohesiveness within its social group.

Although "flehmen," or lip-curl, which involves the closure of nasal openings when the head is jerked back, is a widely distributed behavioral trait in mammals, this facial expression has evolved into a particular sign in horses which elicits particular responses on the part of other horses. A fearful rhesus monkey carries its tail stuck stiffly out behind, while a baboon will convey the same emotion to its fellows by holding its tail vertically.

In brief, each kind of animal has at its command a repertoire of signs that forms a system unique to it or is, in biological parlance, species-specific. Language is a species-specific trait of man; it is therefore counterproductive and misleading to ascribe language to any other animal, except, perhaps, metaphorically. Some features of tail signaling, as of any other kind of communicative device, may vary geographically; linguistic diversity in space may produce dialects, a term which is also used in zoosemiotics to characterize behavioral differences in populations of the same species occupying different areas. Thus langur monkeys in northern India carry their tails up and arched over the back, while the same species in the south carry them up and then looping backward to signify an individual's degree of "confidence."

No species, however, can survive in isolation from other sorts of animals. Each species must live in a vast ecosystem which requires its members to coexist with a variety of neighbors on certain terms. In order to avoid predators, capture prey or in other ways further the mutual advantage of two or more species, animals must have additional code-switching capabilities, an *interspecific* communication system. In parts of India, for example in Kanha Park, some half a dozen hoofed animals occupy a range which they must share with the tiger and lesser carnivores, like the leopard and jungle cat, sloth bear, striped hyena, jackal and an occasional python—to say nothing of man. Each prey and each predator species must communicate with every other within range to enhance the survival of its own kind.

A number of marine fishes specialize in eliminating parasites that plague another species of fish. The "cleaner" fish entices its hosts by means of a sign—the "cleaner dance" or nod swim—which the hosts acknowledge by permitting themselves to be cleansed. The hosts, in turn, know how to invite the cleaners to perform their lustral chores.

The saber-toothed blenny is, by contrast, a fake and a natural opportunist: it mimics the communicative behavior of the harmless cleaner fish in order to deceive the hosts, enabling the impostor to bite chunks off their fins and gills and get away with it. Such deception by mimicry is a common perversion of interspecific communicative processes throughout the animal kingdom.

A famous example of interspecific communication to mutual advantage is found in the savannahs of Africa south of the Sahara, where a bird, called the honey guide, indicates to man the location of beehives that the bird cannot open but on whose honeycombs it likes to feed. This bird produces conspicuous beckoning calls, followed by certain optical signs, until a willing human being finds the hive, feeds the wax to the bird and consumes the honey himself.

How man and animals communicate with one another poses all sorts of interesting problems which require a great deal more study. Man may encounter animals under a wide variety of circumstances that make it necessary for each party to learn—even if never entirely master—the essential elements of the other's code.

Here are some possibilities for contact:

1. Man is an animal's despoiler (e.g. potential exterminator, such as of the starling); or
2. Man is an animal's victim (e.g. of our most devastating killer, the mosquito).
3. Man is an animal's (unequal) partner of symbiont (say, a human host and his household pet guest, like his goldfish or canary).
4. Man is a parasite on an animal (e.g. the reindeer) or the other way around (e.g. the flea and the louse); or the two exist in a state of commensalism (like seagulls following the plough or robins perched on a spade).
5. The animal accepts a human as its conspecific, even to the extent of attempting to mate (as a panda tried with her keeper in London, or a male dolphin with his female trainer in St. Thomas).
6. The animal defines humans as inanimate objects (e.g. when men are in a vehicle driving through a wildlife park).
7. Man subjects an animal to scientific testing and experimentation (*apprentissage*) in the laboratory or to performing in exhibitions (*dressage*), as in the circus.
8. Man tames animals and continues to breed them selectively (domestication).

Each of these situations—and others—involves a crucial understanding on our part of the animals' biologically-given communicative capacity. The success of processes like taming and training depends on our having mastered relevant elements of animals' codes. In order to flourish in our company, each animal must be able to discern man's verbal and/or nonverbal behavior.

All communication systems, especially those of animals, are studied under six major rubrics. I have already mentioned that messages, or strings of signs, are a chief focus of attention, but all messages have to be generated by an emitting organism (source or addresser) and interpreted by one or more receiving organisms (destination or addressee). The kind of messages emitted is dictated by the biological makeup of the source, particularly its sensory apparatus, and the environmental conditions, or context, to which the species has adapted. A message can but rarely be transmitted directly in the shape in which it was generated (quite probably, electrochemically). Messages have to be encoded in a form that the channel connecting the communicants can accommodate. For the message to have an impact the receiving animal must have the key for decoding it back into such a shape (also electrochemical) that its biological makeup enables it to interpret. This is the reason why messages appear in coded form, and why the source and the destination must (at least partially) share either an inherited or a learned code, or, commonly, some mixture of both.

Picture, then, an organism which formulates a message—say, "I want you!"—directed at another individual, a very special one, of the opposite sex within its own species, as a gannet calling out to its mate after prolonged separation at sea during the winter, so that each member of the pair can recognize the other again as they both return to their nesting cliffs. This message is encoded in acoustic form, and the sound waves travel through the medium of air from the vocal organs of one gannet across to the auditory apparatus of the other. Contrast this with the promiscuous scented advertisement of a flightless female silk moth to any male flying by within a radius of a few miles: her glands emit a sex-attraction pheromone (or message-bearing chemical released to the exterior) called bombykol, which is then transported through the air surrounding her, eventually to be picked up by certain receptor organs on the male antennae. Bombykol molecules are absorbed by the hair surface, diffuse to and through the pores and tubules into a fluid, where they hit the membrane, eliciting a cell response which sets the male off traveling to and, perhaps, mating with the stationary female. A single odor molecule (or very few) can apparently trigger an explosive series of events. Among other things, this chain of happenings illustrates an important principle of animal communication: signing behavior often releases far more energy than is used for the act of launching a message.

All messages are encoded to suit the medium and can, accordingly, be conveniently classified in terms of the channel, or combination of channels, employed by the animal in question. Understandably, human being, in whose daily lives speech plays such a prominent part, tend to think of the vocal-auditory link as the paramount channel. Actually, however, the use of sound in the wider scheme of biological existence is rather uncommon: the overwhelming majority of animals are both deaf and dumb. Of the dozen or so phyla of animals, only two contain creatures that can hear and produce functional sound: the arthropods and the chordates. Of the latter, the upper three and a half classes of vertebrates are unique in having all their members capable of sound production as well as—excepting only snakes—of hearing. The methods of sound production vary, of course, enormously from group to group. Not only does our own method seem to be unusual, but, to all appearances, evolved only once in the stream of life. The vocal mechanism that works by means of a current of air passing over the cords and setting them into vibrations is confined to ourselves and, with distinctions, to our nearest relatives, the other mammals—the birds, reptiles and amphibians. (Although some fish use wind instruments as well, they do so without the reed constituted by our vocal cords.) So far as we know, no true vocal performances are found outside the land vertebrates or their marine descendants, the whales. Acoustic communication may take place in air or in water and it varies in range. The human ear can register only a narrow portion of that range. In that respect, we are overshadowed by the smallest bat, by every dog, as well as by many rodents and, no doubt, countless other animals hitherto not investigated.

Optical communication is, similarly, much more extensive than the limits of the human eye might indicate. Our eyes can register only visible light, whereas bees and some other insects are able to communicate in the ultraviolet range. Nocturnal mammals, possessing a "tapetum lucidum" (an iridescent pigment choroid coat causing reflected night eye-shine), are able to "see in the dark," a feat man can accomplish only with the aid of specially-constructed infrared equipment. The sensitivity of our sense organs tends to vary from that of other species: the auditory reaction time of the avian ear has been estimated, for instance, to be ten times that of a human ear. African vultures were shown to be capable of distinguishing, from a height of about 13,000 feet, whether a gazelle lying on the ground is dead or only sleeping; we, even using field binoculars, are unable even to identify the bird soaring at such a height.

Beside the acoustic and the optical channels, animals may rely on chemical signs through their sense of smell, for example, as do many carnivores and ungulates. The dog's superior sense of smell is legendary. I have mentioned pheromones previously; more and more of them are being isolated and analyzed. The "flehmen" of horses, as well as that of bats and a variety of their predators and prey, is also a specialized device for closing the nostrils to rechannel such olfactory substances as female urine to the so-called vomeronasal organ, located on the roof of the palate of the male, where the chemical message is decoded for ultimate interpretation in the hypothalamus. In snakes and lizards, the vomeronasal organ simply registers olfactory substances, but in such animals as antelopes it enables bucks to know the state of a doe—whether, for example, she is in heat.

Advances are rapidly being made in our understanding of communication by means of electrically coded messages in both marine and fresh water environments. In certain animals, notably such reptiles as rattlesnakes and pit vipers, slight changes in temperature can have significance. Tactile communication—by direct contact or through physical conduits as different as the spider's web and tracks of silk or the slime trails of snails and slugs—is practiced in various corners of the animal world.

The integration of a species may be achieved via a hierarchical combination of channels: the social dynamics of a wolf pack depend, for example, on (a) visual signs, especially the subtle repertoire of tail and body displays and facial expressions; (b) vocal signs, including collective "singing"; (c) tactile signs, such as grooming, nibbling, licking, or just lying together in rest and sleep; and (d) olfactory signs, involving scent marking and rolling. These four channels are used either in alternation, according to certain rules (for instance, when a member has lost visual contact with the pack, he may continue to track, at high speed, following a scent) or to reinforce one another. Such supplementation, called redundancy, becomes necessary under certain unfavorable environmental conditions that introduce noise—unwanted signs—into the stream of communication.

People who want to understand how animals communicate must abandon the layman's traditional notion of the "five senses." Many more than five are already known to science, and many others undoubtedly remain to be discovered. Equally important, humans tend to underestimate many animals' sensorial efficiency. Such misestimates, based on ignorance, sometimes lead to ludicrous pronouncements claiming "extrasensory perception" on the part of certain animals, for example, horses. It has been known, however, since 1926, that horses are capable of detecting movements in the human face of less than one-fifth of a millimeter (one millimeter equals 0.0394 inch). A sign consisting of a movement so minute simple escapes the ken of human onlookers. There are assuredly many such phenomena that should be checked and checked repeatedly in every species of animal.

Specialists in zoosemiotics concentrate on one topic, or a combination of topics, among the following:

1. How does the source animal successively formulate and encode its messages? Squids and octopuses, which are mollusks with a truly extraordinary control of color and pattern, have, for instance, arranged their comportments so as to respect the demands of gravity; to be able to achieve this, they have evolved parts which by their physical structure symbolize gravity and movement. The English anatomist, J. Z. Young, has shown in detail how these internal structures are, as it were, miniature models of the universe, and how these features, among others, guide these cephalopods—whose social existence is confined largely to combat and copulation—in their communicative

behaviors, or in other words, how the signs they use signify some change in their inner or outer world or embody some instructions for action.

2. Once encoded, how is the message transmitted—through what channel(s), operating under what conditions? If a multichannel system is involved, as with wolves, what rules determine how channels are to be combined or when an animal is to switch from one to another?
3. How does the receiving animal successively decode and interpret the incoming message? What is its sensory capacity like, what are its limitations? Cicadas are interesting in this respect. While calling to the female, the male abruptly turns deaf to its own raucous song; the female, however, perceives pulses (which, to us, sound like a mere rattle) from the time patterns of which she is able to sort out her species and fly to the correct type of male.
4. What is the total message repertoire in a given species? (Some investigators maintain that each species of birds and mammals has only from about fifteen to forty-five display messages, classifiable into a dozen or so categories.) What form does each sign take? How are signs arranged into strings and what does each concatenation signify—what information is embodied by each complex sign, and how can this be decomposed into smaller meaningful units?
5. What are the properties of the code used by each species? (A code is a transformation, or a set of rules, whereby messages are converted from one representation to another; an animal either inherits or learns its code, or both.) Thus, insects, which do not have a constant temperature, face a problem created by fluctuations in the environment: male grasshoppers are known to double their rates of singing for every 10 degree Centigrade rise in outside temperature, which means that, if the female recognizes the species solely on the basis of the number of pulses per unit of time, which she does, the code, inherent in her nervous system, must allow for temperature differences to enable her to locate the male. Such must indeed be the case, for females at 25 degrees Centigrade, for example, fail to respond to calls of males, at 15 degrees Centigrade.
6. An animal always interprets messages it receives in the light of two different variables: the incoming signal itself; and the specific qualities of the context in which the message was delivered—such as whether the water was quiet or turbulent, whether the display was performed in the emitter's territory or the receiver's, near a cover or in the open, or whether, during the act of communicating, the animals were approaching one another, withdrawing or still. Every previous message, moreover, provides contextual information for the interpretation of every succeeding message. Very little is known about how animals or indeed, people, utilize contextual information,

> but there is no doubt as to its critical importance in every communicative transaction.

There are two fields of complex research that space will not permit me to more than touch upon in this brief survey. One focuses on the question: how have sign systems evolved—that is, changed into communicatory devices from some segment of behavior that previously fulfilled a different function—in one species or another (the study of what ethologists refer to as "ritualization")? For instance, the evolution of human laughter, which also occurs in monkeys and the chimpanzee as the "relaxed open-mouth display," interpreted as a friendly sign of play, has been traced back to a movement that was originally associated, as far back as primitive insectivores, with grooming and respiration.

The other field attempts to deal with the development (or ontogeny) of sign systems in the life of a given individual, from its birth or hatching to maturity. Much fascinating and useful information has come to light, for example, from longitudinal studies of the vocal development of a variety of songbirds, and the crystallization—the reaching of the final adult pattern—of this manner of territorial assertion.

There are many reasons for encouraging the serious study of zoosemiotics. Let me conclude by mentioning only two. We are as yet far from understanding the pathways along which our own nonverbal and verbal communicative abilities have evolved. Zoosemiotics searchingly illuminates both the commonalities and distinctions between human and animal communication.

Second, we share our globe with a great many fellow-creatures but are totally ignorant of—or worse, entertain childlike ideas about—most of them. Sentimental or outright mistaken notions must be replaced by sound knowledge. Therein lies our only hope for establishing realistic, workable communication links with the host of the speechless creatures that form a vital part of our environment.

The Word ‘Zoosemiotics’*

Thomas A. Sebeok

In 1963, in a review article of several books dealing with aspects of animal communication, I casually introduced a newly fabricated endocentric compound ZOOSEMIOTICS, in the following sentence: “The term *zoosemiotics*—constructed in an exchange between Rulon Wells and me—is proposed for the discipline, within which the science of signs intersects with ethology, devoted to the scientific study of signalling behavior in and across animal species”.[1] In this subordinative endocentric construction, the attribute *zoo*—in the combining form pronounced [zoːə]—recurs in such existing compounds as *zoobenthos*, *zooculture*, *zoo-ecology*, *zoogeography*, *zoography*, *zoolatry*, and of course, in *zoology*, with the consistent meaning of ‘animal’.

The head, *semiotics*, in the form *semiotic*, confined in earlier usage to the medical theory of symptoms, seems to have been introduced into English philosophical discourse at the end of the 17th century by John Locke, to cover one of the three branches of contemporary science, the doctrine of signs.[2] The real founder and first systematic investigator of the field, however, was Charles Sanders Peirce. The unique place of semiotic among the sciences was argued by Charles Morris in 1938, and Rudolf Carnap reaffirmed, in 1942, that “the whole

---

* From: Sebeok, Thomas A. 1972. The word “Zoosemiotics”. In: Thomas A. Sebeok. Perspectives in Zoosemiotics (Janua Linguarum. Series Minor 122), 178–181. The Hague, Paris: Mouton.

[1] *Language* 39, 465. See also *Readings in the Sociology of Language*, ed. Joshua Fishman (The Hague, Mouton, 1968), p. 36. The synthesis of the two fields is further discussed in my “Semiotics and Ethology”, in *Approaches to Animal Communication*, eds. Thomas A. Sebeok and Alexandra Ramsay (The Hague, Mouton, 1969).

[2] The history of semiotics and the term *semiotics* are discussed at length in part 1 of my monograph, *Semiotics: A Survey of the State of the Art*. A condensed version of it will appear as a chapter in *Current Trends in Linguistics*, 12: *Linguistics and Adjacent Arts and Sciences* (The Hague, Mouton). An expanded version will then be published as Vol. 7 of the *Approaches to Semiotics* series (Mouton).

science of language … is called semiotic".[3] In 1962, then, Margaret Mead, perhaps by analogy with *semantics* and the like (in contrast to such forms as *logic*), proposed the plural form *semiotics*, but still used predominantly as a singular, as a term that might aptly cover "patterned communications in all modalities".[4]

The initial reactions to *zoosemiotics* were, by and large, negative. They fell into two categories: mild ridicule, usually turning on the free form pronunciation of *zoo* as [*zu*:]; or gentle reproof, motivated by a dislike of a seemingly unnecessary addition to technical jargon. Such is the burden of the comment by Dell Hymes, that "the comparative study of the codes, and the capacities for the use of the codes, of diverse members of the animal kingdom is well established as an aspect of anthropological interest in the study of communication (although the wish to coin other names is not lacking, e.g., the proposal of 'zoosemiotics')".[5] Hymes does not amplify his reference to "other names", nor am I aware of any. In anticipation of such and other kinds of objections, I endeavored to justify my choice in *Science*, in 1965: "In my own work, I have chosen to call this field 'zoosemiotics' partly to avoid using an unwieldy phrase where a single term will do, but more positively, to emphasize its necessary dependency on a science which deals, broadly, with coding of information in cybernetic control processes and the consequences that are imposed by this categorization where a living animal is the transcoder in a biological version of the traditional information-theory circuit".[6] I have continued to use the term wherever this seemed warranted.

I expected the term to be noted, if not adopted, by linguists and other scholars concerned with semiotic processes, but I was unprepared for its incipient espousal in several branches of zoology. In a 1966 ornithological monograph,[7] 'zoosemiotics' is not only entered in the Glossary (with a bibliographical reference to an article of mine in *Science* the year before), but is used, in adjectival form, as the heading of Chapter 9, "Zoosemiotic Comparison". In 1967, 'zoosemiotics' is mentioned by a primatologist, as "this broad, biological ap-

---

[3] Rudolf Carnap, *Introduction to Semantics* (Cambridge, Mass., Harvard University Press, 1942), p. 9.

[4] See my article, "Animal Communication", Science 147, (1965), 1006; for further details, cf. my "Goals and Limitations of the Study of Animal Communication", in *Animal Communication: Techniques of Study and Results of Research*, ed. Thomas A. Sebeok (Bloomington, Indiana University Press, 1968), 3–14.

[5] Dell Hymes, "The Anthropology of Communication", in *Human Communication Theory*, ed. F. E. X. Dance (New York, Holt, Rinehart and Winston, 1967), 11.

[6] *Science* 147, 492.

[7] W. John Smith, *Communication and Relationships in the Genus Tyrannus*, (= *Publications of the Nuttall Ornithological Club* 6) (Cambridge, Mass., 1966).

proach to communication" (with references to the same article).[8] In that same year, another zoologist wrote that "it is still too early to see whether [the term *zoosemiotics*] will be adopted generally",[9] but a specialist on animal acoustic behavior remarks, in 1968, that it "seems quite adequate, since it is a study of a system based on signs whatever their origin may be".[10]

The innovation has now also spread, beyond science, to fiction. In Pamela Hansford Johnson's *Cork Street, Next to the Hatter's: A Novel in Bad Taste*, the following passage occurs: "… I am thinking of starting you on zoosemiotics next term. I can easily get tapes of mynah birds from Indiana".[11] It is highly improbable that Miss Johnson invented the label independently or, indeed, that her usage could have derived from any other source than my 1963 review, on the grounds of both internal and external evidence: first, because the association with Indiana would be too much of a coincidence; second, because the author's husband, C. P. Snow, to whom I spoke in 1961 about my research in animal communication, is regularly furnished with copies of my publications of interest to him (I imagine he received the review in question in 1964, as Miss Johnson was completing her novel).

Early in 1967, I published an article in French where a translation of this word appeared as *zoosémiotique*.[12] Since then, it has cropped up at least twice more: in the anthropological review *L'Homme*,[13] and in the newspaper *Le Monde*.[14] It has also appeared in print in Hungarian (in a journal of linguistics), as *zoosemiotika*;[15] in Czech (in a journal of psychology), as *zoosemiotiku*;[16] in

---

[8] Stuart A. Altmann, "The Structure of Primate Social Communication", in *Social Communication Among Primates*, ed. *idem* (Chicago, University of Chicago Press, 1967), 328.

[9] Hubert Frings, "Animal Communication", in *Communication: Concepts and Perspectives*, ed. Lee Thayer, Second International Symposium on Communication Theory and Research (Washington, Spartan Books, 1967), 297.

[10] Rene-Guy Busnel, "Acoustic Communication", in *Animal Communication: Techniques of Study and Results of Research*, 145.

[11] (New York, 1965), p. 221.

[12] "La communication chez les animaux", *Revue international de sciencesociale* 19 (1967), 94.

[13] Claude Bremond, *L'Homme* 7 (1967), 124.

[14] Alain Rey, *Le Monde* (Septembre 13, 1967), 10.

[15] First citation in *Nyelvtudományi Közlemények* 67 (1965), 306.

[16] *Československa Psychologie* 10 (1966), 1.

Polish (in a journal of philosophy), as *zoosemiotyki*;[17] in German, as *Zoosemiotik*;[18] and in Italian, as *zoosemiotica*.[19]

Although the authorship of a handful of invented English words is known since the 17th century—for instance, of *gas*, *physicist* and *scientist*, *chortle*, *kodak*, and *blurb*—C. F. Hockett justly observes that "we cannot usually know the exact identity of the innovating individual..."[20] If the innovating individual happens to be a linguist, he has an obligation, I think, to state the circumstances of his creation and to trace its history in the language and its spread, so far as he can, in other languages. Such has been my purpose in presenting this brief record of *zoosemiotics*.

---

17. *Studia Filozoficzne* 45 (1966), 163.
18. *Beiträge zur Linguistik und Informationsverarbeitung* 10 (1966), 7.
19. Umberto Eco, *La struttura assente* (Milan, Bompiani, 1968), p. 15, n. 1.
20. Charles F. Hockett, *A Course in Modem Linguistics* (New York, Macmillan, 1958), p. 393.

Chapters from Animal Communication Studies

Introduction

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

Analysis of semiotic processes in animals cannot be effective without a sound knowledge of animal communication, psychology, behaviour and ecology, and this often means turning to classical writings in ethology and other fields of animal communication studies. Relevant books for the student of zoosemiotics can be counted in hundreds if not in thousands. For this section, we have selected some of the most essential writings from the perspective of zoosemiotics, to give an insight into possible approaches in animal communication studies.

The first two texts by Adrian Wenner ("The study of animal communication: An overview") and Heini Hediger (excerpt from *The Psychology and Behaviour of Animals in Zoos and Circuses*) describe the diversity of communicative activities in animals and develop their possible classifications. Orienting in communicative activities of different species may be a serious task for a researcher engaged in empirical studies, who is familiar with many different animal species. For a specialist of animal communication the variety of channels, signal types, ecological relations, gestures, and other characteristics seems rather something like a multidimensional space of variables that is difficult to organize in any reasonable way.

Next we have selected some classical studies of animal communication that have significantly influenced zoosemiotics. These include an overview of Karl von Frisch's studies on the dance language of bees ("Decoding the language of the bee") and a study of the semanticity of vervet monkeys' alarm calls by Robert M. Seyfarth and Dorothy L. Cheney ("Meaning, reference and intentionality in the natural vocalizations of monkeys"). Both texts are short overviews of much more thorough studies on the respective topics. For those who have special interest in these studies, we recommend von Frisch's *The Dance Language and Orientation of Bees* (1967), and Seyfarth's and Cheney's *How Monkeys See the World: Inside the Mind of Another Species* (1990). Both topics have turned into icons of animal communication studies that are described in abridged form in general overviews over and over again, so it would not be a bad idea to become acquainted with the original research as well.

The final part of this section is formed by texts on selected topics in animal communication and behaviour. Play behaviour is introduced by Marc Bekoff and Colin Allen ("Intentional communication and social play: How and why animals negotiate and agree to play") and aesthetic expression in animals is presented by Thomas A. Sebeok ("Prefigurements of art"). Both phenomena—play and aesthetic behaviour—have been to a large extent neglected in contemporary natural science, probably because they cross the human–animal boundary, and also because they are seen as largely non-functional and thus uninteresting to the evolutionary view. However, the combination of those two characteristics makes these two topics especially intriguing for zoosemiotics. Also, the last texts create a possibility to compare two parallel traditions in the research of animal communication—cognitive ethology and zoosemiotics.

The opening text by Adrian Wenner aims to build a general framework for discussing animal communication. Although the reader may wonder if there is really a need for such a theoretical account, Wenner points out that a superficial discussion about animal communication may often include dangers and faults. From the biological perspective animal communication as such is always a generalization, as it refers, or at least should refer to some specific organism and to some type of communication. But is this always specified? When talking about animal communication, do we mean all animals from sponges and insects to higher mammals, or just the latter? And do we include all types of communications from environmental orientation to ritualised mating displays or rather have in mind some specific type? Similar questions rise also in situations where different animal communication systems are compared. Does our comparison have justified grounds in homology or resemblance that could be used as a basis for reasoning? For instance signalling in different channels (visual, auditory, olfactory, tactile) differs a lot because of the different capacities of those channels to carry signals and many other specifications (e.g. sensitivity to eavesdropping, localizability of the emitter). Thus, for instance, comparing birdsong with olfactory communication of insects probably does not provide us with much valuable information.

To talk reasonably about animal communication, one should thus be able to orient oneself in different types of communicative behaviour in nature as well as in biology of species under observation. The typology proposed by Adrian Wenner distinguishes on its basic level between intra-individual, inter-individual (that can be divided further between intraspecific and interspecific) and animate–environmental signals (*see p. 115, below*). All types can be specified further. Such a typology can also be expressed semiotically as a distinction between endosemiosis, exosemiosis and signification, as discussed in our general introduction. Regarding any specific case of communication, many additional characteristics become relevant (e.g. variability of the signals, redundancy within/between signals, ontogenetic development and role of learning, specifics of the sign system, etc., *see p. 118, below*). Using this kind of typological tool can help to describe and compare different animal communication systems, as exemplified by Adrian Wenner's assessment of vocal communication in three species (*see p. 120, below*). In the context of that article, it seems crucial to understand the biological perspective on animal communication—from that particular viewpoint communication is just one facet of the species overall ecological, physiological, evolutionary and behavioural constitution and should also be interpreted in this framework.

When discussing typologies of animal communication and expression we would also like to mention the German theoretical biologist Günter Tembrock, who has extensively elaborated semiotical ethology. Besides other things, he has proposed several conceptualizations of semiotic relations in animals. Thus, Tembrock has distinguished semiotic types of relations between an organism and its environment as spatial semiosis, temporal semiosis, semiosis of metabolism, defensive semiosis, exploratory semiosis and semiosis of partners (Tembrock 1997: 577–586). He has also categorized basic semantic categories that are transmitted in interspecific communication: 1) identity of the sender (species, sex, age, individuality etc.); 2) motivation (physiological status, behavioural status etc.); 3) surrounding environment (dangerous and harmless organism, conditions like food, weather conditions) (Tembrock 1971: 56–57).

In the end part of his text Adrian Wenner makes a short critical remark on the honeybee dance language hypothesis as well as some references to his own research on this topic. As our Reader includes also a text by Karl von Frisch where his views on Adrian Wenner's work are included, we do not need to make an extended comment on this dispute here. The controversy between Karl von Frisch's hypothesis of bee language and Adrian Wenner's odor-search hypothesis has been one of the great intriguing disputes in 20th century science. Today the existence of 'dance language' in honeybees is quite generally accepted, but it is also accepted that odors have a significant role for bees in finding the right flowers. The role of olfactory information in the orientation of honeybees was also actually never denied by von Frisch (*see p. 142, below*). For anyone interested in the history of this controversy, we would suggest an overview by Tania Munz (2005).

Heini Hediger's approach is rather different in style. Hediger was a longtime director of Zürich Zoo and also his text carries an enjoyable feeling of personal experience with animals. As a person who has been in close contact with animals for most of his life, he has many fascinating stories to tell, his text also has respect toward animal cognitive capabilities and skills: "When animals and men meet, it is the rule [...] that the animal can learn more about man from his expression than man about the animal" presuming no special equipment is used on either side (*see p. 139, below*).

In zoos, many animal species live closely together on a restricted territory and this makes the zoo a perfect place to study animal behaviour. Ethological and semiotic knowledge become valuable here as diagnostic devices that allow early detection of stress and illnesses in animals. Here semiotics seems to return to its ancient roots in medical diagnostics—interpreting visible features as signs of irregularity in the inner state of an organism. Heini Hediger has contributed a great deal to zoosemiotics. Besides *The Psychology and Behaviour of Animals in Zoos and Circuses* (1968) whence the excerpt in this Reader has been taken, his essential writings include *Man and Animal in the Zoo: Zoo Biology* (1969) and *Wild Animals in Captivity* (1964). In social studies he is probably best known for his typology of interaction distances in animals and men (Hediger 1964: 12–17, 31–38).

Hediger does not write about communication, but about animal expression, defined as "variable nonpathological phenomena of the animal, which may help to an understanding of their situation" (*see p. 127, below*). For many species face-displays, general posture of the body and movements of the tail are important signals, although the diversity among expressive features in different groups is remarkable. Also, the resemblance between distant groups may easily lead to misinterpretations, for instance when crocodiles are interpreted as smiling because their mouth corners are turned upwards (*see p. 134, below*). To organize his wide knowledge, Heini Hediger uses a typology that distinguishes on its basic level between acoustic, optic, olfactory and internal expressions, all divided further and exemplified with many precise observations. The last category—internal expressions—is somewhat unusual in typologies of animal behaviour. The need for such a category that would include reactions of secreting tract, vomiting, urinating, level of adrenaline etc. could be explained by the specifics of the zoo situation. In zoos animals may experience more stress than in natural conditions, but also their internal symptoms, for instance refusal of food, has a great diagnostic value in zoo biology, indicating that certain shifts have to be made in the diet or living conditions of an animal.

Karl von Frisch's work on honeybee senses is an one-man quest that has had a major influence on the development of animal communication studies. Together with Konrad Lorenz and Nikolaas Tinbergen, von Frisch was awarded the 1973 Nobel Prize in Physiology or Medicine. Thus the studies of von Frisch stand at the heart of classical ethology. There is also an interesting connection between von Frisch and Donald Griffin, the founder of cognitive ethology, who worked on bird navigation and echolocation of bats. After the Second World

War Griffin introduced von Frisch's views in the United States and organized also the publication of his major works. The text included in our reader is actually von Frisch's speech for the Nobel Ceremony and it summarises in a short and readable form the most important stages in this magnificent life work.

Von Frisch's text illustrates well the inner logic of research, how one question or problem can lead to another. The initial research topic of von Frisch was the visual sense of honeybees and his first results, achieved from the field tests with food plates of different tones, concerned their colour vision. Observations on the speed and accuracy with which bees make use of new food sources raised also the question about the mechanism of their sense of direction and information exchange. This led to the amazing discovery of the bee dance language that bees use to communicate the direction, distance and with the help of nectar and pollen samples, also the specific species of flowers in the surrounding environment. Dance language can also be used for other purposes like communicating the location of a suitable place for the new hive (cf. Lindauer 1971: 32–58). Von Frisch's results were revolutionary as they showed that also non-human animals, and, indeed, even animals without mammalian brains, could use a complex coding mechanism to exchange information. In this aspect, honeybee dance language has remained an important example of semiotic capacities of animals. For instance, Winfried Nöth writes in his *Handbook of Semiotics*: "From a semiotic point of view, the 'language' of the bee is a code by which indefinitely many messages can be transmitted" (Nöth 1990: 151).

Similar to the work of von Frisch, studies also by Seyfarth and Cheney on vervet monkey alarm call systems have been conducted in natural or nature-like conditions. This reduces significantly the possibility of human observers' influence on results and thus also the results' vulnerability to the criticism that they embody the Clever Hans type of fallacy. Whereas von Frisch's work highlights the existence of codes and capabilities of coding in animal communication, the article by Seyfarth and Cheney explores another important facet of communication, namely its referential or representational aspect. The referential dimension of message can be formulated as the link between the message and something in the environment that is external to the message and that the message stands for. The existence of a referential dimension in animal communication is actually nothing surprising. There are many examples of this in animals included in Hockett's design list of language under the category of semanticity (Hockett 1960: 408–410). What is remarkable in the vervet monkey alarm call system is the use of auditory signals to denote specific and well-differentiated classes of objects—large ground predators (leopards), aerial predators (eagles), and snakes. Besides different classes of objects, also specific calls are related to specific escape strategies. As a response to the leopard alarm call, vervet monkeys make an effort to climb a tree; in the case of eagle alarm call they hide in bushes, and in the case of the snake warning they rise to an upright position and look around searchingly.

Many explanations have been proposed to decipher such a complex adaptation. For instance, different alarm calls may correspond to the rising level of animals' excitement and fear or they may just indicate the possible future behaviour of the animal, being thus similar to the "follow me" signal of the opened wings in birds. Seyfarth and Cheney support and also partly confirm by experiments the hypothesis of semantic meaning—in other words, that the alarm calls of vervet monkeys are indeed fully semiotic signs, referring to different types of predators. Such semanticity is established if the call signals the presence of an external object, and the call elicits the same response as would its referent when the referent itself is missing (*see p. 159, below*). The explanation is supported by experiments where the reaction of listeners does not seem to depend on the location and activity of the call's emitter; experiments with the habituation to the signals; discussions of ontogenetic development of alarm calls; and, finally, by brilliant interspecific experiments where alarm calls with the same reference by vervet monkeys and superb starling are used. At the same time, the authors' other studies show that vervet monkeys probably do not interpret vocalizations as a representation of the caller's knowledge, i.e. they are not capable of making and using difference between their own and their species-mates' knowledge and the real situation. They are, however, well aware of the difference between objects and signs: "To a vervet, the world is composed of two fundamentally different sorts of things: objects, such as leopards, snakes, or other groups; and vocalizations, which serve as representations of these objects. Monkeys respond to objects according their physical features; they respond to vocalizations according to the things for which they stand." (*see p. 170, below*).

The text by Marc Bekoff and Colin Allen deals with a fascinating phenomenon of animal behaviour and communication—play. Both authors are well-known promoters of cognitive ethology (Allen and Bekoff 1999), a discipline largely parallel to zoosemiotics. Although animal play may at first sight seem to be an object of behavioural studies rather than that of semiotics, play usually takes place between two or more individuals and must therefore be essentially semiotic and communicative. An interesting question from a semiotic viewpoint is: how do animals communicate their intention to play? As already mentioned, play is largely nonfunctional behaviour, but it is also a conditional or abstract phenomenon. It means that in a situation of play, participants act "as if", with a certain detachment from their usual behaviour. Growls and attacks do not lead to fights and group hierarchies are temporally forgotten. Signals used in a play situation may be similar or even the same as in normal communication, but they are interpreted differently. From here rises an intriguing semiotical problem. For social play to occur, participants need to be able to produce and interpret two different types of messages: those of normal communication, i.e. messages of the primary level, and messages of the second level which indicate that the messages of the primary level should be interpreted in the "mode of play". In the words of Gregory Bateson: "These actions in which we now engage do not denote what those actions *for which they stand* would denote" (Bateson [1972] 1999: 180). Marc Bekoff and Colin Allen address this issue in their texts by showing how the canid "play bow" functions as a kind of comment about other signals. This becomes apparent by the placement of "play bow" among other behavioural sequences: Bekoff's study shows that it is usually performed close to other signals (such as playful bites) that could easily be misinterpreted (*see p. 184, below*).

From a cognitive ethological perspective the authors also discuss the connection between play behaviour and animal intentionality. In some critical accounts, the possibility to discuss play in simpler organisms has been refuted exactly on the basis that play behaviour needs to involve many complex physiological phenomena such as high level intentionality and pretence. Such complex mental capabilities are then regarded as characteristics of our species only. However, this question can also be considered the other way around. As Marc Bekoff and Colin Allen suggest, play and playing may be seen as a way to promote learning about the other's intentions (*see p. 187, below*). In a play situation intentions are different when compared to the normal situation and by some means this difference needs to be communicated and interpreted. Thus, play may actually create a possibility to learn the difference between intentions, changing mental stages and reality. To pursue any further interest in play behaviour and its interpretation in cognitive ethology we would suggest the profound study *The Genesis of Animal Play: Testing the Limits* by Gordon Burghardt (2005).

The last article of this section, Thomas A. Sebeok's "Prefigurements of art" develops a comparative and continuous approach to the aesthetic behaviour of animals. Although the size of this text may seem slightly out of balance when compared to the rest of the articles presented in this section, Sebeok's chapter presents issues that are crucial in the discussion of zoosemiotics and cannot therefore be ignored. As an important theoretical basis, Sebeok develops a distinction between verbal and nonverbal art. The former type of artistic behaviour develops form the sign structures of natural languages and secondary regulations built on them, and is therefore characteristic of the human species only. Besides this there is also nonverbal artistic behaviour that builds from more universal semiotic codes and modelling. This type of artistic behaviour is used by many organisms to engage with their environment (*see p. 231, below*).

More specifically, Sebeok discusses four types of aesthetic expressions in animals, calling these kinaesthetic signs, musical signs, pictorial signs and architectural signs. All respective types of art have been considered by some authors as unique features of humans. Sebeok holds an opposite view and provides examples of all these categories as manifested in other animals (artistic behaviour of bowerbirds and apes is discussed at length). One reason why artistic behaviour has been considered as a human feature only lies, perhaps, in its non-functional and non-utilitarian nature. Extending artistic behaviour to other animals would thus mean accepting that also other animals have aesthetic sensation, experiences, preferences and a need for art—with all the philosophical consequences and implications that this may bring along. Alternative functional explanations link artistic behaviour to curiosity and exploratory behaviour as well as the need to appeal to the opposite sex and thus sexual selection. At most, such explanations could form some organizing dimensions in aesthetic behaviour, but they can hardly explain the multifarious and innovative nature of art. Still, Sebeok notes that art and aesthetic experience may have a certain homeostatic function that helps to keep an organism's inner sensations (Uexküllian *Innenwelt*) in balance with its environment (*see p. 218, below*). Thus, rather than being based on some universal principle, from the semiotic perspective artistic experiences could be considered as local and context-oriented phenomena, sign relations that help to bring varied facets of the world harmoniously together and enhance skills of orienting in the world.

References

Allen, Colin and Marc Bekoff
1999 *Species of Mind: The Philosophy and Biology of Cognitive Ethology*. Cambridge, MA: The MIT Press.
Bateson, Gregory
1999 [1972] A theory of play and fantasy. In: Gregory Bateson. *Steps to an Ecology of Mind*, 177–193. Chicago: The University of Chicago Press.
Cheney, Dorothy L. and Robert M. Seyfarth
1990 *How Monkeys see the World: Inside the Mind of Another Species*. Chicago: University of Chicago Press.
Burghardt, Gordon M.
2005 *The Genesis of Animal Play: Testing the Limits*. Cambridge, MA: The MIT Press.

Hediger, Heini
1964 *Wild Animals in Captivity. An Outline of the Biology of Zoological Gardens*. Trans. Geoffrey Sircom. New York: Dover Publications.

Hediger, Heini
1969 *Man and Animal in the Zoo: Zoo Biology*. Trans. Gwynne Vevers and Winwood Reade. New York: Delacorte Press.

Hediger, Heini
1968 *The Psychology and Behaviour of Animals in Zoos and Circuses*. Transl. Geoffrey Sircom. New York: Dover Publications.

Hockett, Charles F.
1960 Logical considerations in the study of animal communication. In: Wesley E. Lanyon and William N. Tavolga (eds.), *Animal Sounds and Communication*, 392–430. Washington: American Institute of Biological Sciences.

Frisch, Karl von
1967 *The Dance Language and Orientation of Bees*. Trans. Leigh E. Chadwick. Cambridge, MA.: Belknap Press of Harvard University Press.

Lindauer, Martin
1971 *Communication among Social Bees. Harvard Books in Biology* 2. Cambridge, MA: Harvard University Press.

Munz, Tania
2005 The bee battles: Karl von Frisch, Adrian Wenner and the honey bee dance language controversy. *Journal of the History of Biology* 38(3): 535–570.

Nöth, Winfried
1990 *Handbook of Semiotics*. Bloomington: Indiana University Press.

Tembrock, Günter
1971 *Biokommunikation: Informationsübertragung im biologischen Bereich* (Biocommunication: Information process in biological sphere) I. Berlin: Akademie-Verlag.

Tembrock, Günter
1997 Ökosemiose. In: Roland Posner, Klaus Robering and Thomas A. Sebeok (eds.), *Semiotik: Ein Handbuch zu den zeichentheoretischen Grundlagen von Natur und Kultur* I, 571–591. Berlin: de Gruyter.

The Study of Animal Communication: An Overview*

Adrian M. Wenner

Introduction

Many scholars, in particular those who are engaged in the recently developing areas of science, have an eagerness, perhaps an impatience, to formulate a comprehensive view of at least part of the world. We wish to categorize, classify, or outline every body of information encountered. Although there is some danger of spending too much time in such activity, and not enough time on gathering additional and valuable information through experimentation, we cannot expect to gain a working familiarity of a field unless we do indulge in some preliminary outlining. This is particularly true in something so broad as the field of animal behavior.

In spite of an eagerness to organize working outlines, we have yet to find a formally stated, comprehensive framework within which we can consider even the field of animal communications.[1] Until we have such a comprehensive view of the relationship among various behavioral acts, we can hardly develop meaningful classifications within more restricted areas of communication. A comparative study of the table of contents of different books on animal behavior bears this out—and reveals emphases ranging from the purely anecdotal to the strictly experimental; but even among books which exhibit a sophisticated structure, the relation among the topics covered is not apparent.

Also, more specifically, some researchers in animal communication may study a limited number of species (or only one) and then attempt to discuss animal communication in general. Others limit themselves to a study of communi-

---

* From: Wenner, Adrian 1969. The study of animal communication: An overview. In: Thomas A. Sebeok and Alexandra Ramsay (eds.). *Approaches to Animal Communication*, 232–243. Mouton: The Hague.

[1] Various outlines of animal behavior do exist (e.g. see Roberts, 1942). In this chapter, however, I strive to produce a logical and inclusive scheme which does not become overly cumbersome.

cation in one channel and then attempt to discuss all of animal communication with reference to what may be true for only one channel—emphasizing the use of a mode rather than the act of communication itself.

In a more specialized realm, behaviorists discuss the possible evolutionary pathway of a particular type of communication, such as mating signals or communication of information about the location of a food source. Again, we find that these discussions may compare communication within a certain act and via one channel, to a communication process which utilizes another channel—implying that a species can abandon one mode and adopt another, or that the use of one type of channel is more primitive than the use of another.

It is also not difficult to find examples wherein an author moves freely from a discussion of communication of a few dissimilar species belonging to a broad group, to a discussion of communication within the entire group (i.e. class order, or family), thus implying greater capabilities for the group than exist for any one of its species (e.g. 'ants' communicate information about location of food source by means of odor trails—though not all ant species do this). The practice leads to an eventual failure of theorists to recognize the limited capabilities of a single species within a group.

We are caught in a dilemma when we try to discover the relationship among the various studies in the field of animal behavior. We find it difficult, for instance, to relate the study of mating behavior of birds to the study of the social structure of a termite colony. Similarly, we find it difficult to ascertain whether each set of anecdotes and experiments is of general interest or is of interest with respect to only one species. Clearly, we need to be better able to decide whether a given discussion, study, etc. relates to a general problem or only reflects the use of a restricted tool in a highly specialized species.

During the Wenner-Gren conference at Burg Wartenstein, Austria, in 1965, it became clear early in the general discussion that our inability to agree with each other on some issues may have been more a result of an attempt to intermesh topics (which may belong to different realms) than a result of having really different facts upon which to operate. These difficulties were spawned, for the most part, by the different views of animal communication held by the participants. We all felt that our lack of a comprehensive view of the entire field of behavior, together with the limitations of our individual interests, contributed to a major part of the impasse at which we arrived on certain issues. A private discussion quickly led to a consensus, the need, and later the development of a comprehensive framework by a portion of the participants. The speed of development of this outline resulted from each of us having utilized (but not having formalized) a similar scheme in our own past work. The comprehensive framework which follows, then, was developed over a period of several years by considering the entire field of animal behavior.

A Catalogue of Behavior

Before proceeding far into the building of a framework, one point needs clarification, namely, the distinction between a study of animal communication and a study of animal behavior. A study of animal behavior largely concerns itself with an analysis of the activities of a sender or receiver, before and after signals (stimuli) pass. A study of animal communication, on the other hand, concentrates on an analysis of those signals which produce certain types of activity and on attendant circumstances which contribute to the activity generated.

Historically, animal behavior has received the more attention of the two, mostly due to our lack of ability (before the recent rapid advances in technology) to accurately measure, dissect, and imitate signals. That is, it is relatively easy to see an animal do something, but it may be very difficult to intercept the signal(s) responsible. Now, however, with the introduction of ever better equipment and methods, we find an increasing emphasis on the effect signals have on the behavior of animals. The value of the broad definition of animal communication which is proposed will become clear after more background information. Not all will agree.

The first decision in building a framework is whether to build the framework about the signals which influence an animal or around the behavioral acts themselves. In actuality, however, much of what constitutes animal behavior is descriptive and subject to varied interpretation. The signals themselves, however, can be measured, analyzed, generated, and tested, providing a firm basis for an objective study of communication. Accordingly, a framework constructed on the basis of the origin and destination of signals is proposed. Such a scheme will not change with future developments in animal behavior and would provide a convenient cataloguing system.

Signals may travel either totally within an individual, travel between two (or more) individuals, or travel between the environment and an individual. (Although the other possibility also exists, that of signals travelling from one point in the environment to another, this is not of general interest to the student of animal communication unless an animal is ultimately involved. Consequently, this is treated as a special case of signals arising from the environment and utilized by an individual). Three main categories thus contain all signals which are of interest to students of animal communication. Of great importance in this connection is that some combination of these types of signals may direct an animal's behavior.

Intra-individual signals (see Table 1) generally fall into the realm of physiology, although animal behaviorists must consider the impact of internal signals on behavior when behavior is presumably elicited in response to signals from the environment (just as a physiologist must be concerned with changes in an animal's physiology resulting from receipt of signals from the environment). Eventually this area will become of great importance to the behaviorist, although a large gap in our understanding and in our technology presently limits the amount of interpretation possible in any attempt to relate behavioral acts to simultaneous signal transmission within an animal.

Of the three categories in Table 1, the second is perhaps the most popular among students of animal behavior, that is, the study of those signals which travel between two individual organisms and the responses of animals after receiving such signals. Within this second category, however, we are immediately concerned with whether the signal passes from a member of one species to an individual in another species or between two members of the same species. One could restrict a definition of animal communication to the latter section of this category and so demand that the field of animal communication encompass only those cases where signals pass between two members of the same species or one could insist that the definition include no more than both sections of this second category. Hopefully, the value of a choice of a broader definition of animal communication will be apparent later.

Behavioral acts taking place after an exchange of signals between members of two different species usually show a different type of relationship than those which occur after an exchange of signals between two members of a single species. Without doubt, the vast majority of these interspecific signals arise in connection with competition, predation, parasitism, or mutual symbiosis. Here one encounters the less clearly defined topics of sham, mimicry, and interspecific territoriality.

If a signal travels from one member of a species to another, the question of sexual function arises. Does a signal evoke aggressive or attractive behavior in the recipient or does it aid in maintaining a hierarchy prior to mating activity? By considering the behavioral pattern together with the origin and destination of the signal(s) responsible for evoking it, a clear relationship emerges.

If, on the other hand, a signal travels between two or more members of a species and does not exhibit an obvious sexual connotation, one suspects a more subtle social function. Basically, this may involve relatively simple social signals, such as alarm or distress calls, or more structured signals functioning in aggregation, familial relationships, or colony organization.

The third category, that in which signals pass from the environment to the animal, includes those signals which result in regulation of behavior with respect to physical parameters. These signals generally effect what the animal does while it relates to its environment. Included herein would be those environmental signals which influence the metabolism of animals and later their behavior—examples of these effects include temperature regulation and biological rhythms. Also in this category would be the familiar studies of navigation, migration, homing, and echolocation.

Table 1 summarizes this entire complex of animal behavior, organized according to the origin and destination of signals. Separation of this pattern into two columns provides for the possibility of shifting different behavioral categories within the second column without the need for changing the basic outline shown in the first column. Obviously, some of these types of behavior (such

Table 1. An outline of animal behavior (based on the origin and destination of signals involving organisms).

Signal Category	Behavioral Examples
I. Intra-individual	(Field of Physiology)
II. Inter-individual	
A. Interspecific Signals	Predation or Escape from Predation (Including Sham and Mimicry) Symbiosis and Parasitism Territoriality (e.g. *Lottia*) Composite Schooling or Flocking
B. Intraspecific Signals	
1. Sexual	Attraction and Mating Rivalry, Territoriality and Hierarchy
2. Nonsexual	
(a) Individual	Play, Aggregation, and Schooling or Flocking Familial Ties
(b) Colonial	Colony Organization Division of Labor
(c) Environmental	Information about Food and Home Location Alarm and Distress Calls
III. Animate-Environmental	
A. Internal	Rhythms and Biological Clocks Temperature Regulation
B. External	Orientation, Navigation, and Migration (Including Foragaing and Homing) Echolocation and Electric Location

as foraging) might be considered as belonging in different parts of the outline simultaneously. The question asked before proceeding into a detailed study, however, usually determines where the topic is placed.

Other Dimensions of the Catalogue

The simple outline proposed in Table 1 does not include several other important criteria necessary in a comparision of particular communication acts among animals. Early in the formulation of this outline a list of factors began to take shape. Eventually this led to a recognition of four realms or dimensions in addition to the basic plan.

One of these factors, the physical characteristics of signals, has already been alluded to in connection with understanding the nature of the channel in which a signal travels before it influences an animal's behavior. Prior to comparing communication in one species and that in another species, one must ascertain the nature of the channel (or combination of channels) employed by the species under observation. One must also decide whether one signal is truly more complex than another signal or whether a different species has evolved a pattern of communication which utilizes some other channel, medium of signal transmission, or signal quality.

These physical features can involve more complicated factors, as well. Can a signal contain information about past or future events or can it be used only at the time of production? Will a wide variety of signals produce a given response, will a given signal produce varied responses, or will a precise signal evoke only a given response? Finally, how much redundancy is present either within a signal or between signals—that is, can an animal substitute one part of a signal for another part or can it substitute a signal in one channel for one in another channel? Related to this last point is the possible need for receipt of signals in two or more channels before a response is elicited.

A second factor, genetic influence, plagues an investigator, if for no other reason than that we cannot understand which behavior (or part of a behavioral act) is genetically controlled until we understand behavioral patterns completely. If one maintains cultures of organisms in the laboratory through several generations, for example, the investigator may have inadvertently (and unwittingly) selected certain behavioral traits. An equally complicating factor is that different populations within a species may show considerable genetic variation in some aspect of communication but not in another.

A third important factor, behavioral modifications, concerns the relationship between two or more individuals or between an individual and the environment at the time of a signal passage. In evaluating this factor, one should have a complete understanding of the role of learning in the utilization of signals, both in adult organisms and in developing individuals. Past experience of the organism may modify a signal or the response to a given signal. Although psychologists of the past tended to emphasize this factor to the virtual exclusion of all other factors, the attitude is now changing (Beach, 1965). Students of invertebrate behavior, on the other hand, have perhaps unnecessarily handicapped themselves by not being cognizant of the possible influence of learning on behavior (see Dethier, 1964). Behavioral modification possibilities combined with the complicating factor of genetic expression leads to a more or less complex state of affairs, for both the emitter and receiver of a signal. This complex must not be minimized by investigators.

The fourth factor which immediately comes to mind, logical considerations, presents perhaps the most difficult aspect of the four. In a study of animal communication one must consider both the possibility that an organism can use single units as specific signals which evoke specific responses, as well as the possibility that an organism can combine these same simple units into the production of more complex signals. These more complex signals may in turn evoke a response unrelated to any response elicited by reception of any of the single units. This leads to the possibility of an open rather than a finite vocabulary for a species. Analysis of the signal itself, however, may not permit a conclusion as to the openness of a vocabulary. One must further know whether the normal receiver of the signal uses an open vocabulary generated by a sender or whether the signal is, in fact, finite so far as the receiver is concerned.

An even more important logical consideration than that of the various characteristics of signals is whether or not we really know if the passage of a particular signal is a communication act which is responsible for evoking the behavioral response which follows. Before one can really classify and discuss the relationships among signals, there must be compelling evidence that a given signal evokes a given response. (One must also be prepared to recognize the fact that compelling evidence of today may not be adequate tomorrow—see Popper, 1957). Unfortunately, we have virtually no compelling evidence for the majority of assertions found throughout the literature, largely because animal behaviorists have often stopped their research projects after accumulating relatively indirect evidence instead of proceeding toward the difficult goal of gathering more direct evidence. It cannot be emphasized too strongly, in this connection, that even an overwhelming number of correlations does not substitute for direct evidence. For a demonstration of the insufficiency of correlations see Wenner, Wells and Rohlf (1967).

Table 2 summarizes and adds to the above discussion. Although certainly not exhaustive, these additional dimensions present a formidable challenge to those of us who wish to embark upon comparative or evolutionary studies of animal communication.

Table 2. Important factors in understanding the use of signals by animals

I. Physical Characteristics
  A. Nature of the channel
    1. mechanical, electromagnetic, chemical, electrical
    2. quality of signals
    3. complexity of a signal
  B. Medium of transmission
    1. air, water, substrate
    2. background noise
  C. Time relationship—past, present, future use of a signal
  D. Variability of signals (vs. stereotypy)
  E. Substitution possibilities
    1. redundancy within a signal
    2. redundancy between signals

II. Hereditary Influences
  A. Population variation
    1. within populations
    2. between populations
  B. Natural selection

III. Behavioral Modifications
  A. Development of use of signals by individuals
    1. innate
    2. imprinting
    3. modification with age
  B. Role of learning in adult use of signals
  C. State of emitter or receiver

IV. Logical Considerations
  A. Use of single units vs. syntaxis
  B. Open or finite vocabulary
    1. on the part of an animal
    2. on the part of an observer
  C. What is known or not known (at any one time)
  D. Objective-subjective nature of a signal

A Limited Application

The above presentation permits a comparison of communication in different species, limited by the uncertainty of our present knowledge. An example of how this might be done is shown in a comparison of communication in three quite disparate species, field crickets, tree frogs, and chickens. The selection of such diverse species avoids the possibility that the communication in these three species exhibits recent evolutionary ties.

Before proceeding into the comparison itself, one must specify requisite conditions under which to operate, since one cannot simultaneously discuss all dimensions of these systems. A consideration of the three species, together with an examination of those factors listed in Table 2, provides a basis for a limited comparison of communication according to the recipients' reaction to signals. These criteria are as follows:

(1) mechanical channel (sound signals)
(2) air transmission
(3) present time (signals reacted to at the time of receipt)
(4) stereotypic signals
(5) redundancy within but not between signals
(6) innate signals
(7) signals without syntaxis
(8) finite vocabulary
(9) signals containing objective, not subjective information

Table 3, based solely on information collected together in one volume (Busnel, 1963), represents this comparison. Although inclusion of these signals in the table implies some degree of certainty as to function, this function is by no means certain in all cases. Attempted construction of similar tables only after knowledge of function was obtained would not be profitable, because of our general lack of compelling evidence in the field of animal behavior.

The original intention was to include a porpoise species and honey bees *(Apis mellifera)* in this table. The lack of certainty of porpoise sound function (except for echolocation), and results from recent experiments on honey bee conditioning (Johnson and Wenner, 1966) and on honey bee language (Johnson, 1967; Wenner, 1967), however, make such inclusion problematical at this time.

The comparison in this table should not be taken as inclusive of all communication in these three species. Each species certainly has a potential for communicating the types of information listed, as well as other information in visual or chemical channels (just as other species have capabilities for communicating information about patterns similar to those shown in Table 3 by use of

Table 3. Limited comparison of three dissimilar species signals involving organisms (based on the origin and destination of signals involving organisms).

Signal Category	*Acheta assimilis*	*Hyla versicolor*	*Gallus gallus*
I. Intra-individual			
II. Inter-individual			
A. Interspecific Signals	Sound of Predator	Sound of Predator	Sound of Predator
B. Intraspecific Signals			
1. Sexual	Calling & Courtship Songs Rivalry Song	Calling & Release of Female by Male Chorus "Leader"	Crowing
2. Nonsexual			
a) Individual			Hen to Brood
b) Colonial			
c) Environmental	Sudden Lack of Sound (Alarm?)	Sudden Lack of Sound (?)	Danger Call Food Call
III. Animate-Environmental			
A. Internal			
B. External			

other channels). So also may these species communicate other information by sound signals.

One can obviously make comparisons of this type among closely related species, leading to further taxonomic and evolutionary comparisons and interpretations. Before proceeding on such comparisons, however, an investigator should first determine that a knowledge of the repertoire of the various species being compared is virtually complete.

Superficial comparison of closely related species, in terms of their methods of communication can be deceiving. Since a species may strongly compete (at least initially) with its nearest relatives in a similar ecological niche (those species which initially have the nearest nutritional and other such requirements), we must accept the possibility that very closely related species may be especially different from each other in terms of communication mechanisms.

Discussion and Summary

This treatise presents an organization of the entire field of animal behavior based upon the nature of those signals which influence behavior. Certain factors are inseparable from this organization and provide an indication of the enormous complexity of the study of animal communication. A study of this organization, together with its factors, can reveal the general relationship between the fields of behavior, learning, and communication. The organization is based, in part, on the context of a signal. If the context, as a result of research, should be found to be different than previously thought, the change will not affect that part of the organizational scheme dealing with the relationship among signals.

Utilization of this framework with the qualifications clearly in mind, on the other hand, permits one to compare communication among various species objectively. An example of this type of exercise is provided as a guide to understanding the application of this outline. Dissimilar species were deliberately chosen to avoid the possibility of confusing similar communication systems with the notion that these systems had a similar evolutionary development.

The framework also furnishes a convenient basis for comparison of different facets of animal behavior study. One is able, for instance, to quickly see the relationship between a study of bird navigation and one of cicada songs.

The outline fails in one important respect. Human language, being basically arbitrary (Hockett, 1960), can be used for communicating information about any section of the outline by any one of the various channels. If a species is able to so freely interchange signals and (or) channels, obviously its communication system does not yield to placement in the organization provided by the proposed framework. Neither does the outline lead to any easy comparison of human language to communication in other species.

Bibliography

Beach, F. A.
1965 "The Snark was a Boojum". In: T. E. McGill (ed.), *Readings in Animal Behavior* (New York, Holt, Rinehart and Winston).

Busnel, R.-G. (ed.)
1963 *Acoustic Behavior of Animals* (Amsterdam, Elsevier Publishing Company).

Detheir, V. G.
1964 "Microscopic Brains", *Science*, 143, 1138–1145.

Hockett, C. F.
1960 “Logical Considerations in the Study of Animal Communication”. In: W. E. Lanyon and W. N. Tavolga (eds.), *Animal Sounds and Communication*, (Washington, D.C., AIBS).

Johnson, D. L.
1967 “Honey Bees: do they use the Direction Information contained in their Dance Maneuver?”, *Science*, 155: 844–47.

Johnson, D. L. and A. M. Wenner
1966 “A Relationship between Conditioning and Communication in Honey Bees”, *Animal Behavior*, 14, 261–265.

Popper, K. R.
1957 “Philosophy of Science: A Personal Report”. In: C. A. Mace (ed.), *British Philosophy in the Mid-Century* (New York, Macmillan).

Roberts, T. W.
1942 “Behavior of Organisms”, *Ecological Monographs*, 12, 340–412.

Wenner, A. M.
1967 “Honey Bees: do they use the Distance Information contained in their Dance Maneuver?”, *Science*, 155, 847–849.

Wenner, A. M., P. H. Wells, and F. J. Rohlf
1967 “An Analysis of the Waggle Dance and Recruitment in Honey Bees”, *Physiological Zoology*, 40, 317–344.

The Animal's Expression*

Heini Hediger

In zoological gardens, where animals from every class of the animal kingdom and from all parts of the globe come together, and in which they should lead pleasant lives under artificial conditions, man should learn far more than anywhere else about the most important ways in which his charges express themselves, and so be able to form a picture of their internal condition from these external signs. If anybody in a zoo mistakes the meaning of these phenomena of expression, he is heading for failure, or will immediately get a reminder in the shape of a surprise defensive action, for example.

That is why the greatest attention must be paid above all to the animals' expressions in the zoo, as these provide an important factor in determining the animals' mental and physical well-being. Characteristic changes in facial expression, and in the body, are of frequent occurrence in most animals.

The more practice one has, the more signs one recognizes in the animal and the greater the range of expression appears. Yet how easy it is for anyone unfamiliar with animals' expressions to be mistaken, can often be seen in the zoo. One of the most astonishing examples I can still remember vividly. While conducting a party of enthusiasts round, I went to see a recently caught marten, not on exhibit but kept for the time being locked up in a service room.

The timid creature had retreated as far as it could, that is, under an inverted sleeping box in a pile of hay it had dragged in. Apparently the marten only left its hiding place at night, when all was quiet, and nobody was about. To a newly caught animal, man always means a deadly enemy. I did not want to disappoint the members of the little party and, with some reluctance, uncovered the hidden marten by lifting up the box that covered it. The animal now lay completely exposed to a dozen staring people. One of them volunteered the remark: "Ah, it's asleep." Hopelessly wrong of course! Far from being asleep, the marten was in a state of extreme excitement, not knowing, after it had recovered from the mo-

---

* From: Hediger, Heini 1968. The animal's expression. In: *The Psychology and Behaviour of Animals in Zoos and Circuses*. Trans. Geoffrey Sircom, 141–153. New York: Dover Publications. Reproduced with permission of Dover Publications. Original figures are not reproduced.

mentary shock, whether to jump at me or to make a dash for the farthest corner of its prison. In this case, sleep was a complete and utter misunderstanding—if anyone had gone too close to the so-called sleeping marten, he would have recognized a state of surprising wakefulness in the form of sharp teeth, and probably would never again have mistaken a sleeping marten for an extremely alert one!

Another instance of a completely topsy-turvy interpretation of an animal's expression was so outstanding that I made a note of it a couple of years ago. In those days, the original stags' house, built in North Scandinavian style, was still standing opposite the raptorial birds' enclosure. In one compartment we had temporarily put an African barbary sheep with its young lamb, and now we had to tackle the problem of getting these two wild sheep back to their flock in another part of the gardens. This seemed so easy and indeed would have been if it had been a question of domestic sheep. The movement of wild sheep, however, can be a ticklish problem, especially when there is no suitable equipment. Thus, for example, there were no drop-doors in the dilapidated old stall—since demolished—but only a useless swing gate, which precluded the possibility of barring in the animals for feeding. The gate was not in the only suitable spot, a corner of the enclosure, but in the centre of the narrowest side, and it projected somewhat into the interior of the enclosure. It was therefore practically impossible to drive the animal along the fence into the stall, since it dashed into the fatal blind corner between the fence and the door, where it stood in great excitement only to break desperately out once more into the middle of the enclosure. There was nothing left but to make a chain of keepers, hem the animal into a corner as quickly as possible, and, by means of a simultaneous grab of several men, to capture it by hand.

Anybody who has never watched a manoeuvre of this sort can have no idea of the agility and strength of a wild animal, especially a wild sheep. The maned sheep managed to break through the ranks repeatedly, forcing us to start hemming it into a corner all over again. Finally three men cornered the animal, which was as out of breath as the keepers, and were about to grasp it by the horns and feet when it turned like a flash and, instead of breaking out at the side, jumped straight into the face of the head keeper, who was standing in the centre. As might be expected, he ducked, but received such a kick on the back from the hind legs of the sheep as it broke out, that it knocked him flat on the ground, and at the same time he was grazed behind his right ear by a glancing blow from a hoof.

The animal was free again and dashed up and down the enclosure. At that moment a lady with a large party of children came on the scene, rummaged around in a paper bag, and, blissfully ignorant of what was going on, cheerfully held out a piece of bread to the foam-flecked maned sheep, as it dashed by her. Excited animals do not react to food stimuli; one can only hope to calm them down with food at the very beginning of a state of upset.

What astonished and interested us was that this lady visitor to the zoo had completely failed to recognize the extraordinary state of excitement of the maned sheep. Let us consider, then, by what signs this could have been recognized. First of all, the total situation, quite apart from the disappointed keepers, panting for breath: the animal was not just running, it was dashing up and down, and along the fence as well. This had nothing to do with play, or desire for exercise; the whole external appearance of its movements was obviously caused by some strong urge or other. Direction, tempo and type of movement of the animal were expressive of extreme distress and excitement.

In addition there were many other characteristics of expression, completely ignored by the lady visitor, and yet which it is the duty of anyone who has to deal with animals to know. Between the tip of the animal's nose and the end of its tail, there was nothing but evidence of a dangerous degree of excitement, which gave us the utmost trouble to reduce and overcome. The nostrils, for instance, were in this case fully distended. The mouth was gaping and foaming with the tongue hanging partly out. Ungulates differ from predatory animals or monkeys in not being able to open their mouths very wide, yet even the relatively narrow opening of this wild sheep's mouth was enough indication of extreme excitement. Its eyes were staring and starting out of their sockets, their expression alone was a typical symptom of upset. Additional signs were the violently heaving flanks and the hoarse panting—an audible form of expression. Its hair was bristling along its back, and its tail stood up vertically stiff, a characteristic sign. In this case, it is true, there was no special cry, as with many other animals; but I think that the characteristics of expression mentioned were enough to tell any observer of average experience what was the internal state of the animal. I have gone into such detail over the case, as I wanted to show that there was a complete misunderstanding between an animal and a human being in the zoo, and this sort of thing unfortunately is commoner than one would suppose.

In spite of a sound knowledge of animals' lives and extensive practical experience, it constantly happens that animals' expressions are misunderstood by man, all the more so if the animal is remote from man in the zoological system, and thus the more dissimilar its construction.

So, until recently, "snakes' dances" have been described and illustrated in the herpetological literature, as examples of highly developed mating ceremonial. Davis (1936) and Stemmler (1935) among others, have described many highly ornamental postures struck by poisonous and non-poisonous snakes during their mating display—corkscrew interlacings or splendid, more attractive lyre-like shapes, *etc.*

Exhaustive investigations into the wealth of snake material in the terrarium at San Diego Zoo, California, have nevertheless led the herpetologist Charles E. Shaw (1948, 1951) to the conclusion that all these snake dances are to be regarded as fighting behaviour between rivals of the same sex and also to give proof of the correctness of his interpretations. What seemed even to experienced observers to be obviously mating behaviour has been shown on closer analysis to be the opposite. Thanks to Mr. Shaw's kindness, the Zoological Society of San Diego has allowed me to illustrate this book with some unique pictures of a fight of this kind between male *Crotalus.* I am most grateful to them for it.

Although animals, particularly wild ones, are as a rule excellent observers, far superior to men, it sometimes happens that they misunderstand one another; in other words they misinterpret the expressions of other animals. In the zoo, where animals that are quite foreign to each other come into contact, this happens comparatively often (*cf.* 1950, pp. 111 ff).

I once watched a harmless example of this sort in "Artis", the Amsterdam Zoo, when the director, Dr. A. F. J. Portielje, now retired, was showing off his tame condor. As soon as this giant vulture spied its human friend, it flew down to the floor of its spacious cage, and hopped over to greet its trusted human friend with outstretched wings. At the same moment, another vulture that until then had been sitting in an adjoining cage without taking any notice, turned in the same direction as the condor, and spread its wings out, exactly parallel to those of its neighbour. A few minutes later, however, this second vulture looked round puzzled, clapped its wings together and walked off again.

What had happened in this case? The second vulture had obviously misunderstood a gesture, an expression on the part of the condor. It considered the spreading of the condor's wings as the expression of a desire to sun itself, and that sort of a mood is very catching among birds. Just like bathing, rest, and preening, sunning often occurs, especially among the larger birds, as a sudden collective state of mind. One begins by spreading out its wings so that the sun's rays catch it vertically; a second follows, and in a twinkling all the others have also done so. In Africa, I watched hundreds of standing marabou storks—whole fields full of them so to speak—apparently turn black as they simultaneously opened their wings to sun themselves. The vulture in Amsterdam Zoo clearly mistook the condor's similar action of greeting, during which it spread its wings out wider. Soon afterwards, it realized its mistake and discovered that the sun was not shining at all.

Anyone critically inclined can of course object that this is just assertion without proof, since I could never know what was going on in the vulture's mind.

The objection is theoretically justified. On the other hand, it must be stated here and now that people who have some experience in this field, and who see hundreds or thousands of animals daily eventually, by noting the expressions, develop a kind of intuition, rather like a doctor's diagnostic sense.

There is no lack of experiments for accurately recording the zoo animals' expressions. For example, Rölf Worner (1940) filmed the facial expressions of Rhesus monkeys. Then each separate picture was projected on to transparent tracing paper and copied, with all superfluous detail omitted. The pictures thus produced were laid on finely meshed graph paper, and the mobile portions of the face plotted at several points on this system of coordinates. In this way, interesting graphs could be made of the combination of separate mimic details, *e.g.*, the movements of the mouth, eyebrows and ears.

The Dutch physiologist and animal psychologist F. J. J. Buytendijk (1935) used much the same method of analysis with film strips to examine the reciprocal behaviour and forms of expression during a fight between a mongoose and a cobra. In the thesis by Rudolf Schenkel (1947) on studies in expression among wolves, many externally visible facial expressions, gestures, examples of bearing, ear movements, as well as a dozen various tail positions are shown in nearly a hundred separate pictures. In many animals, in fact, the tail is a particularly sensitive indicator of inner feelings. This extension of the vertebral column plays such an outstanding part not only in expression but in countless other ways, that Peter Bopp has undertaken to write a thesis in the zoo on the different functions of the tail.

If it was a question of simply defining and classifying the animal's expression according to the needs of zoo practice—for home use, as it were—without having to bother about theoretical claims, we might proceed as follows. By animal expression we would mean only those variable non-pathological phenomena of the animal which may help to an understanding of their situation. Here we must make it clear that it is not always easy to draw a definite line between pathological and non-pathological signs. According to one definition, vomiting, abnormal excrementation, and increased glandular secretion, may count as expression phenomena. For example, diarrhoea in a tropical ungulate may mean: a cold, parasitical attack, errors in diet, or excitement; in practice, a swift differential diagnosis is not always easy (see below). In connection with this, the four following broad main groups of expression phenomena may be distinguished for vertebrate animals, illustrated simply by a few suggestive examples.

1. Acoustic.
2. Optic.
3. Olfactory.
4. Internal.

1. Acoustic phenomena of expression (production of sounds).

In this category one may distinguish:

(a) *Vocal, i.e.* sounds produced through the larynx or syrinx. These include special cries of mammals and birds, the barking of dogs and seals, the purring of the larger cats, and the crying of martens.

(b) *Nasal, e.g.* the whistling of chamois, ibex, tahrs, blue sheep (*Pseudois*), barbary sheep (*Ammotragus lervia*), reedbuck, and marmots.

(c) *Dermal, i.e.* sounds produced by the skin, *e.g.* the rattling of the porcupines, *Oreotragus* and rattlesnakes; the rubbing together of specially shaped scales as in *Echis*, and the gnashing of teeth in bears. Beak clapping, and rattling, noisy in the case of storks and gentle in toucans and owls, may all be included in this category.

(d) *Noises produced with the help of surrounding objects*. The classic example is the already-mentioned "splash-sound" of the frog caused by the impact of its body, under specific flight reaction, hitting the water surface with a characteristic noise, thereby warning its neighbours squatting on the bank. The swimming beaver makes a very similar, albeit louder, sound when he is alarmed in the water, and smacks his wedge-shaped tail hard on to the surface of the water, so that this danger signal carries a long way, and the water spurts up seven or eight feet. The rabbit's (*Oryctolagus*) thumping of its hind legs on the ground is equally characteristic. This danger signal may also be observed in the tame rabbit, when for instance a dog is set running near its hutch and startles it. Porcupines (*Hystrix*) also thump their hind legs noisily against the ground when alarmed. Camels stamp with their forefeet; chamois and tahrs do the same with both feet simultaneously, when in a state of excitement. The well-known drumming of the woodpecker on decayed boughs, on the tin protective caps of telephone posts, or against rattling window panes belongs here, as well as the impatient banging on partition doors by the great cats or bears.

(e) *Other sounds.* These occur, for instance, when fish expel air through change in pressure, when brought up to the surface from the depths of their home waters, or when amphibia are removed from the water. As a territorial demarcation signal the male ostrich uses a lion-like rumbling roar, caused by the inflation of the oesophagus, at the same time closing the gullet above the stomach.

In the zoo, the sound of excrement falling on the ground may partake of the character of expression. This may have practical significance in the case of giraffes; normally, the falling of faeces should give a typical rustling sound. If the excrement is voided in shapeless, pattering portions, this is an important guide to the keeper.

2. Optical Phemomena of Expression.

These may be roughly divided into facial, gesture, and colour-change phenomena.

(a) *Facial.* By this we mean characteristic changes in the facial region, occurring on the physiognomy, the solid architecture, so to speak, of the face. This includes emotionally conditioned changes in:

   i. *Ear position* (*e.g.* in cats, equidae, elephants, red deer).
   ii. *Jaw and lip position* (*e.g.* in bears, rhinoceroses).
   iii. *Whiskers* (*e.g.* in cats, dogs, sea-lions).
   iv. *Crest feathers* (*e.g.* in cockatoos).
   v. *Eye opening*, pupils, eye position (*e.g.* cats, anthropoid apes, parrots, herons).
   vi. *Tongue* (*e.g.* in snakes).
   vii. *Nose* (tapir, elephant, seals).
   viii. *Yawning*, often thought of as an expression of sleepiness, has however quite a different meaning with many animals (hippopotami, monkeys), and is to be interpreted as a danger signal (so-called "temper" yawning).

(b) *Gesture.* This includes especially expression phenomena apart from the facial area, that is, on the body, the limbs and the tail. Two sub-groups may be differentiated; namely static phenomena, which occur as it were at one spot, without change of place, and dynamic, which comprise those which do change position.

   i. *Static*

      General bearing (erect with stilted legs, bent, ready to jump, ready to withdraw, *etc.*). In the case of snakes, the observer is almost exclusively concerned with general bearing; pupils, tongue and sounds may give some help.

      Bristling of the mane (*e.g.* giraffes, wild boars, canine family, maned bovidae, rodents).

      Tail movements (*e.g.* the twitching of the tip of the tail in cats, horizontally and vertically in canidae, erection in ostriches, tucking in and erection in antelopes and canidae).

      Ruffling of feathers (in owls, peacocks, pheasants, *etc.*).

      Display of rump patch (roedeer, antelopes and red deer).

Stamping (chamois, tahr, maned sheep, horned sheep, mouflon, camelidae, *etc.*).

ii. *Dynamic*

Tempo of movement forward.

Kind of step (*e.g.* goose-stepping in deer). The kind of step has also proved to have important expressive value in man (G. Kietz, 1952); similar studies for animals would be most interesting.

(c) *Change in colour.* The colour change in cephalopods as an expression of internal state is famous. Blushing and turning pale in man—even though this does not depend on the contraction and dilation of chromatophores as in the octopus—are included among those phenomena. The chameleon is the classic example; its change of colour is less the result of camouflage than of mood. Many fishes are in no way inferior to the famous reptile in this respect. Even bare patches of skin on birds, and the ears of the Tasmanian devil (*Sarcophilus*), for instance, have quite different coloration, according to the emotional situation.

3. Olfactory expression phenomena.

These, too, occur in many forms, even in *Homo sapiens*. The lie detector, as is well known, depends upon variations in the electrical conductivity of the skin according to the activity of the sweat glands. For man, a predominantly optically orientated creature, it is used to detect by eye, with the aid of a galvanometer, these variations in the glandular activity. On the other hand, macrosmatic mammals, *e.g.* the dog, are able to interpret directly through the nose, thanks to their literally superhuman sense of smell, such changes in the functioning of the glands without having to transform them optically. Thus the dog has rightly been described as "microlfac" (R. and R. Menzel, 1930, p. 170), and many of the dog's apparently mysterious reactions to man's emotional state or illness are to be ascribed to this capacity. Many diseases, that are accompanied by characteristic changes in the scent formation, might thus be diagnosed very early with the help of a dog (Katz, 1948, p. 72).

In addition to the optically perceptible, there are also mimicry and physiognomy of smell, usually accessible only to macrosmatic animals. In exceptional cases, men in whom the sense of smell has been particularly well cultivated, find it possible to detect scent mimicry in animals, *e.g.* mice (Hediger 1946).

Functional changes in those animals with very strong skin glands are clearly perceptible even for humans provided with an average sense of smell. Many animals have definite stink glands, *e.g.* many prosimia, stoats, polecats and their kind. The skunk (*Mephitis*) is an extreme case, actually using its glands for defence and, under critical reaction, shooting a real poison gas, namely butylmercaptan, at its opponent.

The counterpart of the skunk among birds is the hoopoe (*Upupa epops*). While in the nest, the nestlings and the female are able to eject their excrement with fair accuracy, at the same time producing from their perineal glands a most offensive secretion (E. Sutter, 1946). Bats can produce from their facial glands a stinking secretion, when threatened. I have no space to detail the numerous examples of offensive glandular scent changes in the various species; I simply draw attention to J. Schaffer's comprehensive work (1940) in this connection.

4. Internal expression phenomena.

Here, I am not so much thinking of the secretion of adrenalin, of the traumatic Basedow disease in rabbits, *etc.*, but principally of the reactions of the digestive tract (in the widest sense) to disturbances, such as we often see in the zoo, or during the capture of animals. Here one is tempted to think of the well known phenomenon in human beings, when in certain emotionally caused situations one's tongue sticks to the roof of one's mouth, *i.e.* the typical reaction of the salivary glands.

Anyone who handles snakes knows how carefully they must be treated after feeding (voluntary or forcible) to prevent them ejecting the whole of the contents of their stomach. The same thing happens with many lizards, *e.g.* monitors. The slightest disturbance can lead to regurgitation. This stomach sensitivity can also be observed in other Sauropsidae, in birds, especially in those which do not fill their crops with fine particles of food but gulp down large chunks into their stomachs or gullets, as is the case with fish-eaters (pelicans, ibis, and herons). Many raptorial birds also vomit up the contents of their stomachs. In the case of many birds, this may help them to escape from enemies by allowing swifter, unencumbered flight. Small seed and insect eaters do not show this phenomenon.

Naturally we include here the emptying of the bladder in conditions of excitement, *e.g.* in elephants. Great bats that have been frightened use their urine as a weapon of defence as well, sprinkling their enemies with it with astonishing precision. Toads and tortoises often manage to gain their freedom for a moment through a sudden surprise emission of urine, when they are being unnecessarily handled by human beings. Many amphibia react to rough handling by emitting poisonous skin gland secretions.

During the daily zoo inspection, the zoo manager has to keep an eye open for a thousand and one possible indications of expression. Not only his eye, but his ear and even his nose must play an active part. There may be many discords in the thousandfold chorus of sounds, from the peacock's warning screech to the porcupine's rustling, the Himalayan tahr's whistling to the emu's trumpeting. Frequently the nose of the man who looks after animals recognizes particular smells, which, as the outcome of a change in gland activity, may act as important symptoms of internal conditions. In prosimia, many of the smaller predators, and rodents, a quick change in the scent formation according to the mood of the moment may be observed. Not everyone responsible for animals goes so far in the interpretation of such scent signs as some experts on mice, who believe they can identify surprising variations in the internal state of their tiny charges through the change of body smells.

The meaning of internal expression phenomena is evident to the observer in the zoo, not only in striking variations in appetite but in a really drastic way when, for instance, he walks unexpectedly into the heron's cage shortly after feeding time. These fish-eating birds express their dislike of that sort of disturbance by emptying their stomachs, and sending a regular shower of fish down on the human intruder. Pelicans, too, react to the least disturbance by completely emptying their stomachs; the business of cleaning out their pond, or repair work in the vicinity of their cage, is enough to cause this.

Refusal of food comes into the category of internal expression phenomena in zoo practice. When, for instance, emus are transferred from one cage to another, fasting for weeks afterwards may result. The elephant is well known for the sensitivity of its intestines. The most trivial thing may cause a change in functioning, such as the flight diarrhoea in elephants in the wild, known to all elephant hunters. The slight disturbance connected with crossing over a busy motor road in Africa may cause a watery evacuation of the bowels in an elephant.

Camels, too, are sensitive in this respect. A camel foal that we were training to walk through the town responded to every forcible walk outside its familiar enclosure with increasing diarrhoea. The further it got from its well known stable, the faster did its originally firm round droppings turn to watery ejections, until eventually, after carefully graduated practice walks, the disappearance of this significant wateriness, together with other symptoms of course, proved to us that the camel no longer objected to short excursions outside its enclosure.

Every one who looks after anthropoid apes knows that these popular show animals possess a very expressive digestive canal. Even slight scolding may entail a great increase in cleaning-up operations.

Naturally, highly developed mammals in particular betray by their facial play, their cries, their tail movements, and so on, a wealth of expressive phenomena which must be noticed by even the outsider. In mammals, the whole body is like an open book, to be read by those who know how. Every item, from the way the hair lies, to the position of the tip of the tail, has its special meaning. As a rule, the closer one gets to an animal, the clearer one finds the expressions of its condition, *i.e.* the external symptoms of the mood. On the other hand, there is a large number of expression phenomena we can understand the first time we meet, as they are more or less non-specific or resemble those with which we are already familiar in other animals. Indeed, some human grimaces are found in much the same form in animals.

There are, of course, animals which are markedly lacking in powers of expression. Thus reptiles and most birds have very little facial expression, or none at all. Among the larger predators, bears, especially polar bears, are feared, because one cannot tell from their faces what they are up to. That is why trainers have such a hard task with these animals. In the case of completely strange species of animals which are encountered for the first time, one may be completely at a loss to start with, but even with the lower vertebrates, a number of facts appear on closer inspection, which may help in determining the state of mind of a fish, a salamander or a tortoise. In fishes, for instance, a very good indication of its internal condition is given by the way the fish moves about in the tank. Madly brushing along the sides of the tank and swimming up and down in a corner are unmistakable signs of discomfort. A fish that is used to swimming around its tank, just as a bird that knows its aviary, never touches the boundaries of its living space but shows by its elegant sweeping movements its awareness of those limits. Other aids are the fish's change in colour, and the action of its fins—often surprisingly accurate and precise indicators of internal state of affairs. There are fish, such as our common native minnows, which may show a distinct colour change on escaping. Many fish have very mobile eyeballs, and can thus roll their eyes.

Moreover, the fact that the most important facial nerve in human beings, the nervus facialis, in this branch of the animal kingdom, controls a considerable region, that of the gill-covers, shows how wrong it is to regard these denizens of the water as expressionless. These very gill-covers, with their degree of splay and the rhythm of their movements, are highly expressive organs to the student of fish. Here too, as with many mammals, there appears an overlapping of functions in many cases, and this frequently leads to mistaken interpretations of the animal's expression.

In the African elephant, for example, the ears, that is, the giant ear flaps, may be highly important expression organs; at the same time they are useful regulators of the body temperature. At certain degrees of temperature and humidity, these organs, with their large area and good blood supply, move according to certain rules. The movements thus set up may be confused with purely expressive movements, and deceive the observer. In deer, the independently movable ears are used for detecting sounds, but may suddenly, when turned as far back and down as possible, form the part of a facial expression, with the meaning of complete readiness for battle. In climbing fish, the splaying of the gill-covers, otherwise a sign of defence or disturbance, may, in certain situations, sometimes be used to help the fish to creep along. Often the gill-covers of fish are provided with a variety of mechanical or chemical weapons in the shape of spines and stings. With them, the splaying of this organ is not just an "empty" gesture, but an actual preparation for fighting, a final warning, a threatening gesture.

It is very often difficult to know the proper meaning of breathing movements. Rapid pulse and breathing in man may sometimes, as we know, be a very significant symptom, or simply the result of physical activity. In many amphibia, breathing movements are hard to interpret. Olga Leffler was the first to point out, in 1914, that the frequency of gill movements in the axolotl depends to a certain extent on its nervous condition. In this familiar salamander-like amphibian from Mexico, nowadays a universal laboratory animal, the external gills project behind the head like delicate tufted fans, and move with a definite rhythm to and fro. Naturally, this movement depends on water temperature, oxygen content, *etc*., and on state of mind, too. If an axolotl is gently stimulated, the number of gill movements per minute can be increased threefold.

In amphibia without external gills, the movements of the skin of the throat, the so-called gular oscillations, are important measures of the degree of excitement, as they are in turtles, particularly the aquatic species. For the rest, the reptiles are as extraordinarily varied in their phenomena of expression, as they are in their external appearance. The crocodiles, and their relatives, present the greatest difficulties to the observer. It is of course a completely mistaken and inadmissible anthropomorphism to say that these armoured lizards wear a constant smile on their faces, just because the corners of their mouths are turned upwards between their powerful jaws. We really have very little to go on to help us to guess even approximately the internal state of a crocodile. The few reliable indications include the pupils, which may be almost completely circular not only in the dark but also in states of excitement; they become extremely thin vertical slits when the animal is in a calm and settled mood. This poverty of expression, which is so alarming in zoo practice, is the reason why one is not prepared for the sudden explosive reactions of crocodiles, interrupting their states of stony rigidity.

Some snakes may show more signs of expression, even though they have no external arms and legs. Vibratory tail movements among rattlesnakes, as well as many other poisonous New World snakes, are valuable danger signals.

The darting tongue, the bellows-like respiration, frequently accompanied by hissing, and the manner of twining are full of significance. In snakes, the whole body has become an organ of expression. Everyone who keeps snakes knows that it is the front third of the total body length that needs one's attention. If this part is formed into an S-shape, like a coiled spring, so that at any moment it can be shot surprisingly far forward, one must act with all possible caution; if, however, the front part of the snake's body is stretched out flat, this is a sign of harmless confidence.

We find among the higher mammals the greatest wealth of expression phenomena. Not all of them, however, are so easy to read as the lion, with its almost exaggerated grimaces and cries. I always feel that he is trying to give human beings, who are rather slow in the uptake, elementary lessons in the meaning of animal expressions. Yet his nearest relations, leopards, pumas, and tigers, make it much less easy for us.

Charles Darwin pointed out the many similarities and even correspondences in his far-reaching work "Expression of the Emotions in Man and Animals". One important difference between man and animals, however, lies in the fact that conscious deception through shamming, *i.e.* falsified expression, really occurs in man alone. The pretence of lameness, in the crane or golden plover, the famous shamming dead of the opossum, or the often doubted but really genuine shamming sleep of the fox has certainly nothing to do with deception. We look for this characteristic in vain in the animal kingdom, a fact which has earned for animals many friendships with human beings. Exceptions occur only among trained animals, whose characters, as D. Katz (1927) expresses it, have been "tainted by man's fall from grace", and occasionally among very highly developed species, such as anthropoid apes living in close contact with man.

An example of a chimpanzee of this sort has already been referred to in the chapter on Play and Training. Another very illuminating one was that of the Gorilla "Achille" in Basle Zoo that employed all his cunning to entice people into his cage in order to satisfy his overpowering need for society. It is not difficult to gain the friendship of young apes; it is much more difficult to rid oneself of these faithful creatures after a time.

One of the countless tricks that the four-year old gorilla used for procuring human contact was to push its arm out through the top of the wire mesh of his air-conditioned cage and pretend that he couldn't get it back again. Several times Head Keeper Carl Stemmler, before he realized that it was all a humbug to try to get some human company, hurried to help the gorilla out of its plight.

As these tricks had been seen through by the whole staff of keepers, it was by a queer stroke of fate that a new and quite inexperienced assistant woman keeper was working in the bird house, where the ape's air-conditioned cage was. A particularly unfortunate chain of circumstances brought it about that one day, at closing time, the new assistant was left alone in the house after the head keeper and the other keepers had already gone.

As the girl was looking around just before going home, her glance fell upon "Achille", who, instead of lying on its wooden bed, was hanging in obvious despair high up from the cage bars and struggling unsuccessfully to free its arm from them. Not surprisingly, the young assistant felt sorry for the poor creature, and wanted to get it out of its plight. Instead of phoning me to report the incident, she thought she would effect the rescue by herself, took out the key of the gorilla's cage, and stepped inside to go to its assistance. The sly gorilla must have foreseen this humane action, for it was waiting, just behind the door, for the assistant. No sooner was this opened than the young ape, weighing a good seventy pounds, jumped up and clasped the assistant round the neck before she got inside the cage, forcing her back under the impact of this overwhelming encounter and down the three steps into the outer room, the food store with which the gorilla was familiar.

The new assistant naturally had only one thought—to get her precious charge back into his cage again. This she managed to do; she slammed the cage door behind her, but in the heat of the struggle, she had dropped the key in the outer room. So there she was, sitting in the air-conditioned cage with the gorilla, still "lovingly" clinging round her neck. By a malicious twist of fate, her absence was not noticed at the check-out point, where she should have made her daily report.

It was not until the next morning that it was learnt, to everybody's horror, that the poor, but fortunately strapping girl, had had to spend the whole night in the gorilla's cage, clasped all the time by the gorilla that pined for somebody's company!

From time to time, when the gorilla dozed off, she tried to loosen its tender, but none the less close, embrace. The little gorilla would then regularly wake up, and cling even more closely to its foster mother. Next morning we found the animal-loving lady keeper, who unfortunately had not been missed at home overnight, in relatively high spirits, although completely wet through, and not very presentable, and we were able to release her from a situation one does not get into every day.

It is unnecessary to add that the press played up this incident for all they were worth: the girl became a Hollywood lovely, the young gorilla a full-grown monster, and in the next few days a number of visitors came to the zoo on purpose to view the girl concerned and the gorilla. About eighteen months later we learned to our great surprise that the baby gorilla, Achilles, now famous, was a female. In this species of anthropoid apes, sex determination is notoriously difficult, and in the case of young animals practically impossible (Hediger, 1952). In animals that have gained special experience through intimate contact with man, it not only happens that they sometimes practise shamming on human beings, as the examples quoted about apes show, but also that they can interpret human expressions expertly. Thus I remember a certain Airedale terrier that had little opportunity of frisking about because it was shut in a small front garden. This was about four feet or so above street level and was separated from it by iron railings. I often used to walk past this garden on my way to town, especially when going to give a lecture and consequently rather preoccupied. It often happened that the dog, obviously bored, suddenly barked at me from about shoulder height and gave me a thorough fright—to its obvious amusement. Significantly enough, this unexpected barking only occurred when I was deep in thought.

If the dog was in the street, for a change, it never thought of barking as I walked past. Similarly it refrained from barking suddenly when I was not preoccupied, and let it understand that I had already seen it by giving a gentle call as I passed. Sooner or later it would happen that I did not think about the dog until too late, whereupon it again played its little trick and startled me.

Simulation is thus apparently not impossible in animals that have been "spoilt" by close contact with man, *i.e.* trained or domesticated. Thus for example E. Frauchiger (1945, p. 193) describes dogs that pretended to be weak or lame when they had to work; "but when they thought nobody was looking, they dashed about playing with bones in the kennels or racing after their kennel companions".

The interpretation of animals' expressions is not always easy, as the examples quoted earlier have shown. It is thus no accident that the greatest blunders of this century in animal psychology can be ascribed, in the last analysis, to misinterpretation of animals' expressions, for instance the catch words "marsupialian stupidity" and the historic error concerning thinking horses and dogs—the Clever Hans error as D. Katz called it.

It is hard to understand nowadays how, less than forty years ago, distinguished and worthy people as well as scientists could have fallen victims to such a gross delusion. A few lines from the published works of two well known Basle personalities suffice to illustrate this remarkable aberration.

Professor Gustav Wolff, a psychiatrist (1914, p. 457): "Once more a great and revolutionary event has occurred, outside all organized science. Like everything else that is new, it has to fight against the dogmatic attitude of scholars and the church. Suspicions are being repeatedly voiced; but the work accomplished is so great that genuine doubts among those who seek the truth can only contribute to its fulfilment, while incompetence and malevolence can no longer harm it. Whoever has been to Elberfeld and Mannheim, and seen the miracle with an open mind and without prejudice, knows that animals can think like human beings, and can express human thoughts in human language—I do not know if I should have believed thus had I not myself experienced it with, I might almost say, awe."

Dr. Paul Sarasin, the well known naturalist and spiritual father of the Swiss National Park, says in the *Transactions of the Society of Natural History of Basle* (1915, p. 71): "Our eyes have been almost dazzled by the results of the new science of animal pedagogy, and they must first get accustomed to the light that shines forth from the abundant observations for which we are indebted to the unflinching efforts of Karl Krall and Frau Paula Mökel, as well as to the important inferences for our conception of the world arising therefrom; but when we eventually succeed in doing so, however great the astonishment we feel at the Mökel results, however much we are taken aback or perplexed, we still are unable to admit that in one particular intellectual activity, that is, in working out difficult arithmetical problems in their heads, the animals mentioned, especially the horse, could be superior to us, that is, to the average man. Yet it is unquestionably established that Herr Krall's stallion 'Muhamed' in particular gives the right answers out of its head to sums involving square roots, which few of us could solve in a short time, while the right answer to the problem is always forthcoming with disconcerting speed. I have already pointed this out as a problem in my first report (1912, p. 252), and I draw attention to the fact that I emphasized this as a problem, in order to establish at the outset that all the critics were wrong to think that we, who were already convinced after repeated personal investigation into the justice of the Krall-Mökel claims, had not realized the seriousness of the problem involved. On the contrary, we knew it only too well, at least as well as Krall's critics, if not better. This is not said in order to boast, but to forestall stupid attacks."

We know today, as we have already said, that these apparently alarming performances by thinking dogs and horses were pure illusion, and that the authorities who fell for them were guilty of unsurpassed naiveté with regard to expression phenomena, not only on the part of the animal, but of the human beings concerned. Today there exists a wealth of literature on this subject, which we cannot even hint at here, unfortunately, but must confine ourselves to one fundamental observation.

The most serious sources of error were discovered by a variety of authorities, including O. Pfungst, who died much too young. Above all the fact was established that certain actions of the talking animal could be attributed to definite involuntary signs.

In the animal kingdom, and among mammals in particular, there is an extremely widespread and remarkably highly developed faculty of interpreting human expression, usually with great accuracy. One might expect the domestic animal, which has been so intimately connected with man for centuries to be able to understand and act upon man's signs better than the wild animal. Animals, especially domestic ones perhaps, are better observers and more accurate interpreters of expression than men, if we exclude his technical aids such as films, microscopes, psycho-galvanometers, *etc.* When animals and men meet, it is the rule therefore that the animal can learn more about man from his expression than man about the animal, provided the higher animals and man without any special equipment are concerned. Many animals in fact are equipped with literally superhuman sense organs and superior strength and shortness of reaction time.

If that were not the case, when capturing animals or in running zoos, there would not be the continual surprises that are the result of a real superiority of the animal in certain fields of sensory activity and bodily organization.

References

Buytendijk, F. J. J.
1935 Reaktionszeit und Schlagfertigkeit. Kassel.
Davis, D. D.
1936 Courtship and Mating Behaviour in Snakes. Zool. Ser. of Field Mus. Nat. Hist. Chicago. Vol. 20, pp. 257–290.
Frauchiger, E.
1945 Seelische Erkrankungen bei Mensch und Tier. Bern.
Hediger, H.
1946 Zur psychologischen Bedeutung des Hirschgeweihs. Verh. Schweiz. Naturf. Ges. Zürich, pp. 162–163.
Hediger, H.
1950 Wild animals in captivity. An outline of the biology of Zoological Gardens. London.
Hediger, H.
1952 Seltene tropische Tiere und ihre Haltung in Zoologischen Garten Nordamerikas. Acta Tropica, Vol. 9, pp. 97–124.
Katz, D.
1927 Charakterologie und Tierpsychologie. Jahrb. Charakterol. Vol. 4, pp. 359–384.
Katz, D.
1948 Mensch und Tier. Studien zur vergleichenden Psychologie. Zürich.
Leffler, O. H.
1914 Zur Psychologie und Biologie des Axolotls. Abh. Ber. Mus. f. Natur- und Heimatkunde. Naturwiss. Verein Magdeburg. Vol. 3.
Menzel, R. and R. Menzel
1930 Die Verwertung der Riechfähigkeit des Hundes im Dienste der Menschheit. Berlin.

Sarasin, P.
1915 Über tierische und menschliche Schnellrechner. Verh. Naturf. Ges. Basel. Vol. 26, pp. 68–95.

Schaffer, J.
1940 Die Hautdrüsenorgane der Säugetiere. Berlin and Vienna.

Schenkel, R.
1947 Ausdrucksstudien an Wölfen. Behaviour. Vol. 1, pp. 81–129.

Shaw, Ch. E.
1948 The Male Combat "Dance" of Some Crotalid Snakes. Herpetologica. Vol. 4, pp. 137–145.

Shaw, Ch. E.
1951 Male Combat in American Colubrid Snakes with Remarks on Combat in Other Colubrid and Elapid Snakes. Herpetologica. Vol. 7, pp. 149–168.

Stemmler, C.
1935 Beitrag zur Fortpfianzungsbiologie europäischer Colubridae. D. Zoolog. Garten N.F. Vol. 8, pp. 38–41.

Sutter, E.
1946 Das Abwehrverhalten nestjunger Wiedehopfe. Der Ornithol. Beob. Vol. 43, pp. 72–81.

Wolff, G.
1914 Die denkenden Tiere von Elberfeld und Mannheim. Süddeut. Monatsschr. pp. 456–467.

Wörner, R.
1940 Theoretische und experimentelle Beiträge zum Ausdrucksproblem. Zs. angew. Psychol, und Charakterkunde. Vol. 59, pp. 257–318.

Decoding the Language of the Bee*

Karl von Frisch

Some 60 years ago, many biologists thought that bees and other insects were totally color-blind animals. I was unable to believe it. For the bright colors of flowers can be understood only as an adaptation to color-sensitive visitors. This was the beginning of experiments on the color sense of the bee.[1] On a table outdoors I placed a colored paper between papers of different shades of gray and on it I laid a small glass dish filled with sugar syrup. Bees from a nearby hive could be trained to recognize this color and demonstrated their ability to distinguish it from shades of gray. To prevent too great a gathering of bees, I instituted breaks between feedings. After these breaks, only sporadic scout bees came to the empty bowl and flew back home; the feeding table remained deserted. If a scout bee, however, found the bowl filled and returned home successfully, within a few minutes the entire forager group was back. Had she reported her findings to the hive? This question subsequently became the starting point for further investigations.

In order that the behavior of foragers could be seen after their return to the hive, a small colony was placed in an observation hive with glass windows, and a feeding bowl was placed next to it. The individual foragers were marked with colored dots, that is, numbered according to a certain system. Now an astonishing picture could be seen in the observation hive: Even before the returning bees turned over the contents of their honey sack to other bees, they ran over the comb in close circles, alternately to the right and the left. This round dance caused the numbered bees moving behind them to undertake a new excursion to the feeding place.

But foragers from one hive do not always fly to the same feeding source. Foraging groups form: One may collect from dandelions, another from clover, and a third from forget-me-nots. Even in flowering plants the food supply often

---

* From: von Frisch, Karl 1992. Decoding the language of the bee. In: Jan Lindsten (eds.). *Nobel Lectures, Physiology or Medicine 1971–1980*, 76–88. Singapore: World Scientific Publishing. Reproduced with permission of Nobel Media.

[1] K. von Frisch, *Zool. Jahrb. Abt. Allg. Zool. Physiol. Tiere*, 1 (1914–1915).

becomes scarce, and a "feeding break" ensues. Were the bees in the experiment able to alert those very same foragers who were at the bowl with them? Did they know each other individually?

To settle the question, I installed two feeding places at which two groups from the same observation hive collected separately. During a feeding break, both groups stayed on the honey-comb and mingled with each other. Then one of the bowls was refilled. The bees coming from the filled bowl alerted by their dances not only their own group but also bees of the second group, which responded by flying to their customary feeding place where they investigated the empty bowl.

However, the natural stopping places of bees are not glass bowls but flowers. Therefore, the experiment was modified; one of two groups of bees collected food from linden blossoms, the other one from robinias. Now the picture changed. After the feeding break, the bees returning from the linden blossoms caused only the linden bees to fly out again; the robinia collectors paid no attention to their dances. On the other hand, when bees returned successfully from robinia blossoms, the linden bees showed no interest in their dances, while members of the robinia group immediately ran to a dancer in their vicinity, following along behind her and then flying out. Some clever bees also learned to use both sources of food, depending on the occasion. They would then send out the linden gatherers after returning from the linden source, and the robinia gatherers after visiting the robinias. Thus, the bees did not know each other individually. It appeared that the fragrance of the specific blossom attached to their bodies was decisive. This was confirmed when essential oils or synthetic scents at the feeding place produced the same effect.

When feeding was continuous, new recruits showed up at the food source next to the old foragers. They, too, were alerted by the dance. But how did they find their goal?

Peppermint oil was added to the feeding place next to the hive. In addition, bowls with sugar syrup were put on small cardboard sheets at various places in the nearby meadow; some of the sheets were scented with peppermint oil and the others with other essential oils. The result was unequivocal: A few minutes after the start of feeding, recruits from the observation hive appeared not only at the feeding place next to the foraging bees but also at the other peppermint bowls posted at some distance in the meadow. The other scented bowls, however, remained undisturbed. The smell of lavender, fennel, thyme oil, and so forth had no attraction. When the scent at the feeding place was replaced by a different one, the goal of the swarming recruits changed accordingly. They let themselves be guided by the scent on the dancers.

Scent is a very simple but effective means of communication. It attains full significance, however, only in combination with another condition. If the sugar syrup becomes scarce or is offered in weaker concentrations, after a certain point the dancing becomes slower and finally stops even though the collecting may continue. On the other hand, the sweeter the sugar syrup, the more lively and lengthier the various dances. The effect of advertising is thereby enhanced, and it is increased further by the scent gland in the forager's abdomen which is activated upon arrival at a good source of supply. Thus it signals "Come hither!" to recruits searching in the vicinity. Many female insects have scent glands to attract the male. In worker bees, which are mere workhorses devoid of any sexual interest, the scent organ is put to the service of the community.

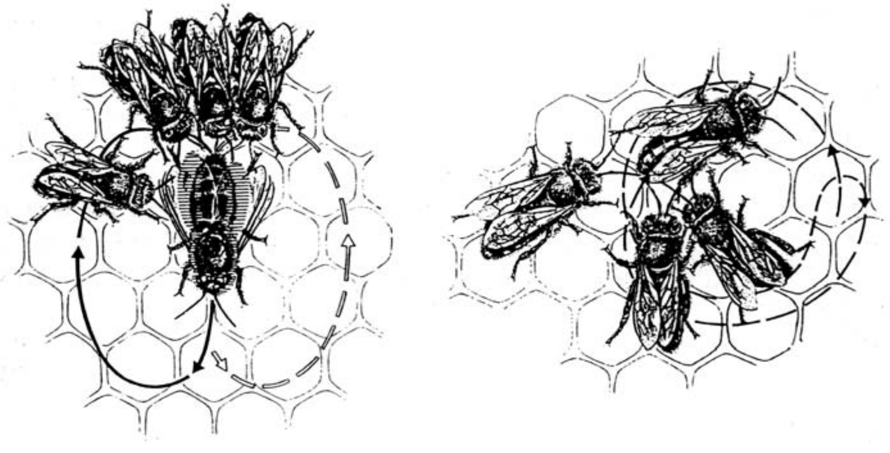
Let us now imagine a meadow in the spring. Various types of plants blossom simultaneously, producing nectar of differing concentrations. The richer and sweeter its flow, the livelier the dance of the bees that discover and visit one type of flower. The flowers with the best nectar transmit a specific fragrance which ensures that they are most sought after. Thus, in this simple fashion, traffic is regulated according to the law of supply and demand not only to benefit the bees but also to promote pollination and seed yield of plant varieties rich in nectar. A new and hitherto unknown side of the biological significance of flower fragrance is thus revealed. Its great diversity and strict species specificity communicate a truly charming scent language.

This was how things stood in 1923[2], and I believed I knew the language of the bees. On resuming the experiments 20 years later, I noticed that the most beautiful aspect had escaped me. Then, for the first time, I installed the feeding place several hundred meters away instead of next to the hive, and saw to my astonishment that the recruits immediately started foraging at that great distance while paying hardly any attention to bowls near the hive. The opposite occurred when the foragers located the sugar syrup, as before, near the hive. Could they possess a signal for distance?

Two foraging groups were formed from one observation hive. One feeding place was located 12 m from the hive, the other at a distance of 300 m. On opening the observation hive, I was astonished to see that all foragers from nearby performed round dances, while long-distance foragers did tail-wagging dances (Fig. 1). Moving the nearby feeding place step by step to greater distances resulted in the round dances changing to tail-wagging dances at a distance of about 50 m. The second feeding place was brought back step by step, past the first feeding place close to the hive. At the same critical distance of about 50 m,

---

[2] K. von Frisch, *ibid.* 40, 1 (1923).


a. Round dance

b. Tail-wagging dance

Figure 1. Running curve of the bee (a) during round dance and (b) during tail-wagging dance. Bees that follow the dancer take in information.

the tail-wagging dances became round dances [3,4]. I had been aware of the tail-wagging dance for a long time, but considered it to be typical of pollen collectors. My mistake was due to the fact that, at that time, bees with pollen baskets always arrived from a greater distance than my sugar syrup collectors.

Thus it became evident, and subsequent experiments confirmed[5], that the round dance is a signal that symbolically invites the hive members to search the immediate vicinity of the hive. The tail-wagging dance sends them to greater distances, not infrequently several kilometers. The signal "closer than 50 m" or "farther than 50 m" alone would not be of much help. In fact, however, the pace of the tail-wagging dance changes in a regular manner with increasing distance: its rhythm decreases. According to the present state of our knowledge, information on flight distance is given by the length of time required to go through

---

[3] K. von Frisch, *Experientia* 2, No. 10 (1946).

[4] The threshold of transition from the round dance to the tail-wagging dance varies with each race of honeybees; according to R. Boch [*Z. Vergl. Physiol.* 40, 289 (1957)], it is about 50 m for *Apis mellifica carnica*, about 30 m for *A. mellifica mellifica* and *A. mellifica intermissa*, about 20 m for *A. mellifica caucasia* and *A mellifica ligustica*, and 7 m for *A. mellifica fasciata*. The fact that the strain we used mostly in our experiments, the Carniolan bee, has the largest round dance circumference was of benefit in our experiments.

[5] K. von Frisch, *Österreich. Zool. Z.* 1, 1 (1946).

the straight part of the figure—eight dance in each repeat. This straight stretch is sharply marked by tail-wagging dance movements and simultaneously toned (in the true meaning of the word) by a buzzing sound[6,7]. Longer distances are expressed symbolically by longer tail-wagging times. For distances of 200 to 4500 m, they increase from about 0.5 second to about 4 seconds[6,8]. (Fig. 2).

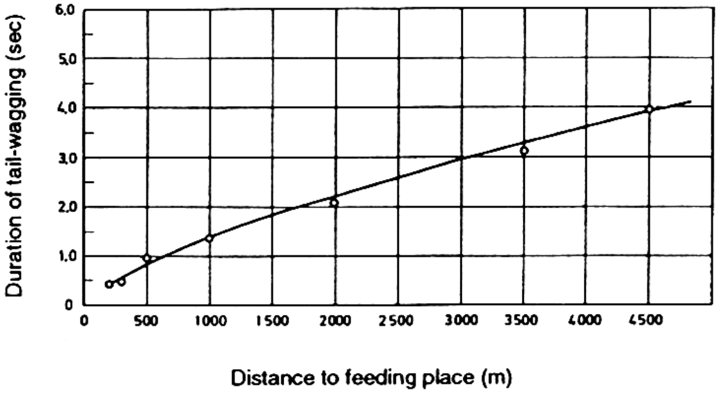


Figure 2. Duration of the tail-wagging run for feeding places at various distances; based on film data.

The tail-wagging dance not only indicates distance but also gives the direction to the goal. In the observation hive, the bees that come from the same feeding place make their tail-wagging runs in the same direction, whereas these runs are oriented differently for bees coming from other directions. However, the direction of the tail-wagging runs of bees coming from one feeding place does not remain constant. As the day advances the direction changes by the same angle as that traversed by the sun in the meantime, but in the opposite rotation. Thus, the recruiting dancer shows the other bees the direction to the goal in relation to the position of the sun[5,6]. Those hours at the observation hive when the bees revealed this secret to me remain unforgettable. The fascinating thing is that the angle between the position of the sun and the dancer's path to the goal is expressed by the dancer in the darkness of the hive, on the vertical surface of the comb, as an angular deflection from the vertical. The bee thus transposes the angle to a different area of sense perception. Figure 3 shows

---

6. K. von Frisch, *Tanzsprache und Orientienung der Bienen* (Springer-Verlag, Berlin, 1965) (English translation: *The Dance Language and Orientation of Bees* (Belknap, Cambridge, Mass., 1967). Further references are found in this book.
7. H. Esch, Z. *Vergl. Physiol.* 45, 1 (1961); A. M. Wenner, *Anim. Behav.* 10, 79 (1962).
8. K. von Frisch, K. von Frisch and R. Jander, *Z. Vergl. Physiol.* 40, 239 (1957).

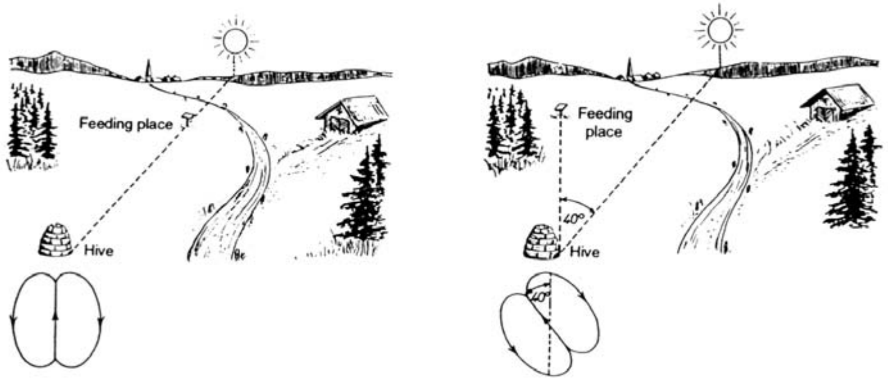


Figure 3. Indication of direction by tail-wagging dance. (Left), the goal is in the direction of the sun; (right), the goal is 40° to the left of the sun's position. Dance figures, enlarged, are on the bottom left of the pictures.

the key to the transposition. If the goal lies in the direction of the sun, the tail-wagging dance points upward. If the goal is located 40° to the left of the sun's position, the dancer shifts the straight run 40° to the left of the vertical, and so forth[5,6]. On the comb, members of the hive move after the dancer and maintain close contact with her, especially during the tail-wagging runs, and take in the information offered. Can they follow it and with what accuracy?

The indication of direction was tested by us using the following method[9]. At a certain distance from the hive, a feeding place was installed at which numbered bees were fed on an unscented platform with a sugar solution so dilute that they did not dance in the hive and therefore did not alert forager recruits. Only at the start of the experiment did they receive concentrated sugar solutions slightly scented with (for example) lavender oil. At 50 m closer to the hive, plates baited with the same scent but without food were placed in a fan-shaped arrangement. The number of forager recruits arriving at the plates was an indication of the intensity with which they searched in various directions. Figure 4 shows, as an example, the result of an experiment in which the feeding place was located 600 m from the hive.

Since such fan experiments proved that indication of direction was successful, we made a step-by-step test of distance-indicating procedures. Here, all scented plates were located in the same direction as the feeding place, from the hive area to a distance well beyond the feeding place. Figure 5 gives an example

---

[9] I use the word "us," since the open-field experiments had assumed such proportions that they could no longer be carried out without trained assistants.

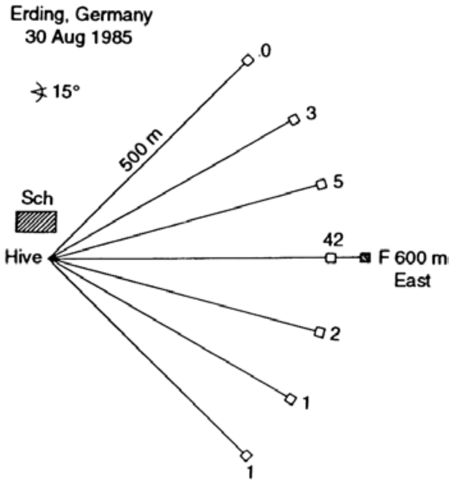


Figure 4. Fan experiment. The feeding place (*F*) is 600 m from the observation hive. Scented plates without food are arranged in fan shape 550 m from the hive. The numbers indicate the number of forager recruits arriving during the first 50 minutes of the experiment; *Sch*, shed.

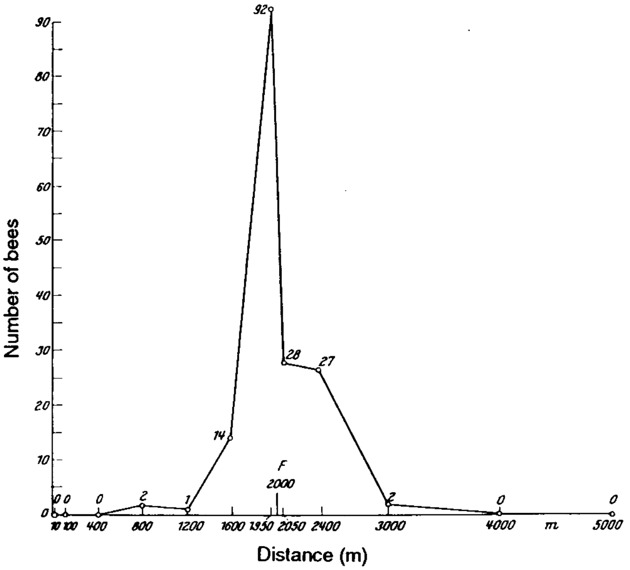


Figure 5. Step-by-step experiment. The feeding place (*F*) is 2000 m from the observation hive. The numbers indicate the number of forager recruits that settled on the scented plates (without food) during the 3-hour observation period.

of an experiment in which the feeding place was located 2 kilometers from the hive. Incoming flights of forager recruits to the feeding site itself were of course not evaluated because here an additional attractant was created by the food and the visiting bees[6].

To sum up, this and preceding experiments taught us that the information on the direction and distance of the goal was adhered to with astonishing accuracy—and not only in gathering nectar and pollen. The same dances are observed on a swarm. Here the scout bees indicate to the waiting bees the location of the domicile they have discovered. Of greatest interest here is that the intensity of the promotional message depends on the quality of the domicile discovered, that the various groups of scouting bees compete with each other, and that therefore the decision is finally made in favor of the best domicile[10].

While not doubting that direction and distance of the goal can be discerned from the tail-wagging dances, a group of American biologists led by A. M. Wenner does not agree that the forager recruits make us of this information. According to them, these bees find the goal by using their olfactory sense only[11]. This view is incompatible with many of our results[6, 12]. It is refuted by the following experiment, to cite only one.

Numbered bees from an observation hive collected at a feeding place 230 m from the hive. The hive was turned on its side so that the comb surface was horizontal; the sky was screened. Under these conditions, the dancers could orient themselves neither by gravity nor by the sky, and danced confusedly in all directions. Plates with the same scent as that at the feeding place were located at various distances in the direction of the feeding place and in three other directions. They were visited in all directions and in great numbers by forager recruits (Fig. 6), with no preferences being given to the direction of the feeding place. The observation hive was now turned back 90° to its normal position so that the dancers could indicate the direction of the goal on the vertical comb surface. Within a few minutes, the stream of newly alerted bees flew out in the direction of the feeding place; the scented plates in this direction were increasingly frequented, and in a short time no forager recruits at all appeared at the scented plates in the three other directions (Fig. 7). No change had occurred at the sources of scent in the open field or in the other external conditions. The change in the behavior of the forager recruits could be attributed only to the directional dances.

---

[10] M. Lindauer, *Z. Vergl. Physiol.* 37, 263 (1955).

[11] A. M. Wenner, *The Bee Language Controversy: An Experience in Science* (Educational Programs Improvement Corp., Boulder, Colo., 1971).

[12] K. von Frisch, *Anim. Behav.* 21, 628 (1973).

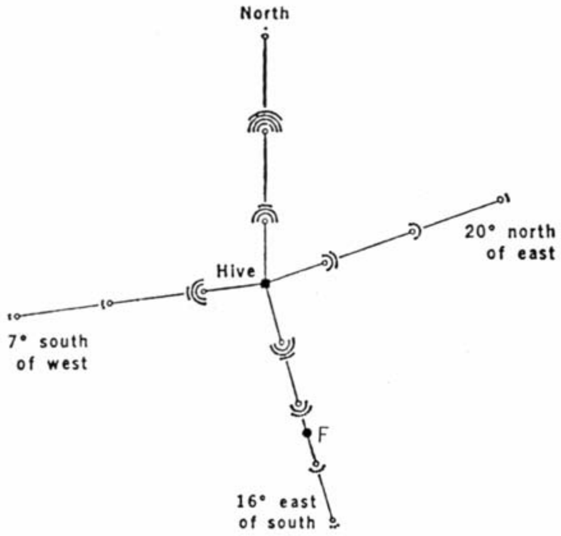


Figure 6. Effect of placing observation hive horizontally. The dances are disoriented. Scented plates with the scent of the feeding place are visited by great numbers of forager recruits (small dots) in all four directions; *F*, feeding place.

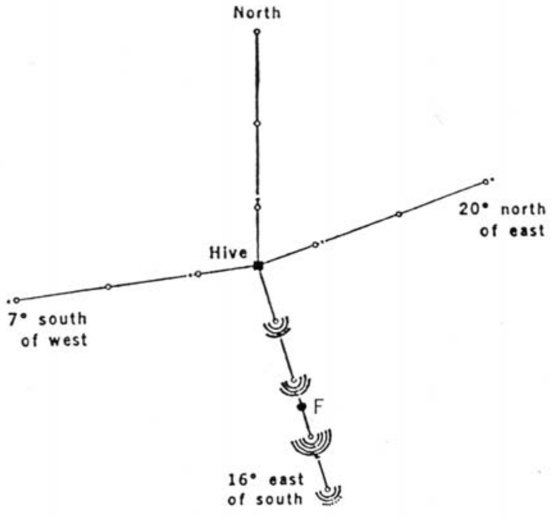


Figure 7. Hive placed vertically after experiment in Fig. 6. The dances now indicate the direction of the feeding place. Within 10 minutes the stream of forager recruits turns in this direction. Flights no longer arrive in the three other directions.

It is conceivable that some people will not believe such a thing. Personally, I also harbored doubts in the beginning and desired to find out whether the intelligent bees of my observation hive had not perhaps manifested a special behavior. I opened an ordinary hive, lifted up one of the combs and watched the expected dances. Curious as to what would happen, I turned the comb in such a way that the dancing area became horizontal. Gravity as a means of orientation was thus eliminated. However, without any signs of perplexity, the bees continued to dance and by the direction of their tail-wagging runs pointed directly to the feeding place, just as we show the way by raising an arm. When the comb was turned like a record on a turntable, they continued to adjust themselves to their new direction, like the needle of a compass[13].

This behavior can be studied at leisure at a horizontal observation hive. It is basically very easy if we recall that the direction of the tail-wagging run relates to the sun's position. During the tail-wagging run on the comb, the bee has only to set itself at the same angle to the sun as it maintained during its flight to the feeding place (Fig. 8). Afterward, when the recruits set their line of flight at the same angle to the sun, they are flying in the direction of the goal.

Figure 8. The principle of direction indication during the dance on a horizontal plane. The bee (right) during the tail-wagging run positions itself in such a way that it views the sun from the same angle as earlier during its flight to the feeding place (left).

This type of discretional indication is nothing unusual. Incoming foragers not infrequently begin to dance facing the sun on the horizontal alighting board of the hive if they are met here by nonworking comrades. The transmission of information through horizontal dancing is easier to understand than that when the angle is transposed to the vertical comb surface. We also seem to have here the original, phylogenetically older type of directional indication. In India there still exist several strains of the species *Apis.* My student and co-worker, Martin Lindauer, went there to use them for "comparative language studies." The small honeybee, *Apis florea*, is on a more primitive level than our honeybee and other Indian strains. The colony builds a single comb out in the open on a branch; the

---

[13] K. von Frisch, *Naturwissenschaften* 35, 12 (1948): *ibid.*, p. 38.

comb has a horizontally extended top edge that serves exclusively as a dancing floor. When these bees are forced onto the vertical comb surface of the side, they cannot render the sun's angle by dancing and their tail-wagging dances become disoriented[14].

Let us now return to our own bees and the observation of dances on a horizontal hive. There can be no doubt that the sun's position is decisive for the direction of their dancing. The sun may be replaced by a lamp in a dark tent. By changing its position, the bees are made to dance in any desired direction. But there was one big puzzle. To prevent excessive heating during most of the experiments, a protective roof was installed over the observation hive. The dancers were unable to see the sun. Nevertheless their dance was usually correct. Orientation by heat rays, by penetrating radiation, as well as other explanations seemed possible and had to be discarded—until I noticed that a view of the blue sky is the same as a view of the sun. When clouds passed over the section of the sky visible to the bees, disoriented dances immediately resulted. Therefore they must have been able to read the sun's position from the blue sky. The direction of vibration of polarized blue light differs in relation to the sun's position across the entire vault of the sky. Thus, to one that is able to perceive the direction of vibration, even a spot of blue sky can disclose the sun's position by its polarization pattern. Are bees endowed with this capacity?

The following test furnished an answer. The observation hive was set horizontally in a dark tent from which the dancers had a lateral view of a small area of blue sky. They danced correctly toward the west where their feeding place was located 200 m away. When a round, rotatable polarizing foil was placed over the comb in a way as not to change the direction of the vibration of the polarized light from that part of the sky, they continued to dance correctly. If, however, I turned the foil right or left, the direction of the bees' dance changed to the right or the left by corresponding angle values.

Thus, bees are able to perceive polarized light. The sky, which to our eyes is a uniform blue, is distinctly patterned to them [13,15]. They use this extensively and, in their orientation, guide themselves not only by the sun's position but also by the resulting polarization patterns of the blue sky. They also continue to recognize the sun's position after it has set or when it is obscured by a mountain. Once again the bees appear to us miraculous. But it is now clear that ants and other insects, crayfish, spiders, and even octopuses perceive polarized light and use it for orientation, and that among all these animals the human being is the unendowed one, together with many other vertebrates. In one respect, how-

---

14. M. Lindauer, *Z. Vergl. Physiol.* 38, 521 (1956).
15. K. von Frisch, *Experiential*, 210 (1950).

ever, bees remain singular: Only they use polarized light not only for their own orientation but also to communicate to their colonies the direction to a distant goal[6].

Thus the language of the bee, which was initially brought to our attention by the physiology of sense perception, has now led us back to it. It also had already led to general questions of orientation in time and space. When bees use the sun as a compass during their own flights as well as to inform their comrades, one difficulty arises: With the advancing hour of the day, the sun's position changes, and one would imagine that it can serve as a geographic marker for a short time only.

I had long contemplated an experiment whose execution was postponed from one year to the next by the feeling that it would not amount to much. However, in the early morning of a fall day in 1949, we sealed the entrance of our observation hive standing in Brunnwinkl on the shore of the Wolfgangsee, transported it across the lake, and placed it 5 km away in a completely different area unknown to the bees[15]. Numbered bees from this colony had visited a feeding place 200 m to the west on previous days (Fig. 9). From the familiar lakeshore and steep wooded hills they now found themselves in flat meadows; none of the known landmarks could be seen. Four feeding bowls with the same scent as at the former feeding place were placed 200 m from the hive toward the west, east, north, and south, and the entrance was then opened. Of the 29 marked bees that had visited in the west during the previous afternoon in Brunnwinkl, 27 found the bowls within 3 hours: 5 in the south, 1 each in the east and north, but 20 in the west (Fig. 10). Each was captured on arrival and was thus unable to send others out by dancing in the hive. Only the sun could have guided those who arrived. It, however, was southeast of the hive, while on the preceding day during the last foraging flights it had been close to the western horizon. Bees possess excellent timing, an inner clock, so to speak. During earlier experiments, by feeding at certain hours only they trained themselves to arrive promptly at the table at that time—even if the table was not set. The above trial, repeated in many modifications[6,15,16], has now taught us that they are also familiar with the sun's daily movement and can, by calculating the hour of the day, use this star as a true compass. The same discovery was simultaneously and independently made by Gustav Kramer using birds[6].

During the past few years, an old and persistent question has opened a new field of work for bee researchers. In discussing the direction indication, I initially kept something from you. The dancers did not always point correctly to the food sources. At certain hours they were markedly off to the left or the right.

---

[16] M. Renner, *Z. Vergl. Physiol.* 40, 85 (1957); *ibid.* 42, 449 (1959).

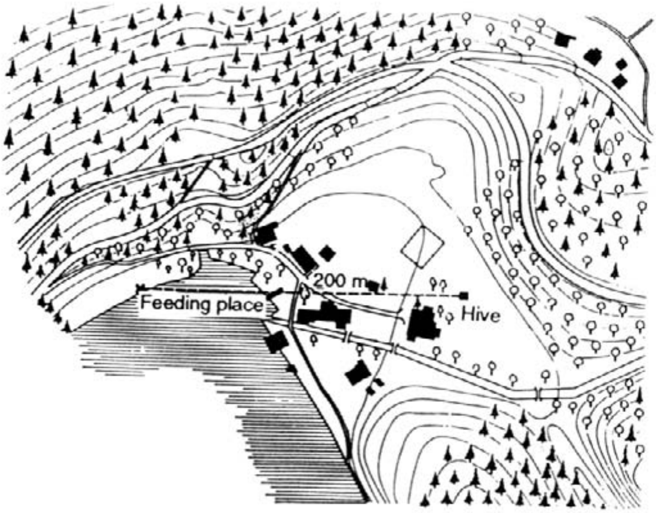


Figure 9. Observation hive in Brunnwinkl on the Wolfgangsee and line of flight of a group of numbered bees to feeding place 200 m west.

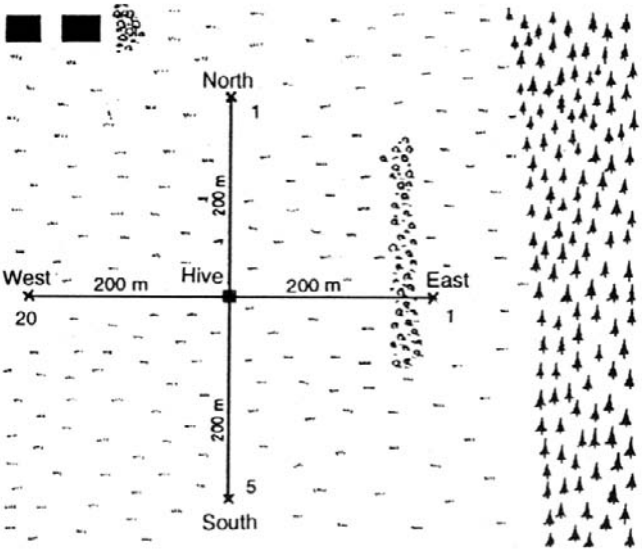


Figure 10. The hive in Fig. 9 transported to a scene unfamiliar to the bees. Small feeding platforms with the familiar scent were placed 200 m from the hive in each of the four directions. The numbers indicate the numbers of arriving bees in the experimental group.

However, no inaccuracies or accidental deviation were involved; the errors were consistent and, when recorded under the same conditions, time and again gave the same curves for a typical daily routine. Thus they could correct, for example, for a different spatial position of the comb. Errors arose only with transposition of the dancing angle; in horizontal dances there is no "incorrect indication of direction." Observations over many years, made jointly with my co-worker Lindauer, finally led us to a conclusion which seemed acceptable[6]. However, it was disproved by Lindauer, who persisted in his experiments together with his student H. Martin. They recognized the magnetic field of the earth as a cause for incorrect indication of direction. If this is artificially screened out, the error disappears; and by artificially altering the course of the lines of flux, the incorrect indication of direction was changed correspondingly[17]. The idea that the magnetic field might play a role in the puzzling orientation performance of animals was rejected for a long time. During the past years it has been confirmed by new observations, especially in birds and insects[18]. Nothing so far points to the possibility that bees, in their purposeful flights cross-country, are making use of the earth's magnetic field. Unexpectedly, however, it proved equally significant biologically but in a different way. When a swarm of bees builds its combs in a hive furnished to them by the beekeeper, their position in space is prescribed by the small suspended wooden frames. In the natural habitat of the bee, perhaps in the hollow of a tree, there are no wooden frames present. Nevertheless, thousands of bees labor together and in the course of one night achieve an orderly structure of parallel combs; the individual animal works here and there without getting instructions from a superintendent. They orient themselves by the earth's magnetic field and uniformly have in mind the comb position which they knew from the parent colony.

However, these are problems whose solution is fully underway, and we may expect quite a few surprises. By this I do not mean that problems such as the perception of polarized light have been conclusively solved. On the contrary: A question answered usually raises new problems, and it would be presumptuous to assume that an end is ever achieved.

It was not possible to present more than just a sketchy illustration in this lecture and to point out a few important steps in the development of our knowledge. To corroborate and extend them requires more time and work than the outsider can imagine. The effort of one individual is not sufficient for this. Helpers pre-

---

17. M. Lindauer and H. Martin, *ibid.* 60, 219 (1968); M. Lindauer, *Rhein. Westjäl. Akad. Wiss. Rep. No.* 218 (1971).
18. H. Martin and M. Lindauer, *Fortschr. Zool.* 21, Nos. 2 and 3 (1973).

sented themselves, and I must express my appreciation to them at this time. If one is fortunate in finding capable students of whom many become permanent co-workers and friends, this is one of the most beautiful fruits of scientific work.

Meaning, Reference, and Intentionality in the Natural Vocalizations of Monkeys*

Robert M. Seyfarth and Dorothy L. Cheney

When humans use words like "apple" or "eagle," we recognize the referential relation that holds between such signs and the things for which they stand. Referential relations can, for instance, be distinguished from causal relations: The word "eagle" does not cause a particular bird to appear or result in a particular pattern of behavior. Instead, the word "stands for," or "conjures up images of," an object even when that object cannot be seen.

Representational capacity occupies a pivotal role in studies of human language, animal communication, and the mechanisms that underlie them because it concerns not only how organisms communicate but also how they classify features of their environment. Given the extensive research that has documented the ability of captive nonhuman primates to learn referential communicative signals in the laboratory (e.g., Premack, 1976), we focus in this chapter on the vocalizations used by nonhuman primates under natural conditions. We begin by asking whether monkeys, apes, or any other animals ever use sounds to denote objects and events in the world around them. If so, are their vocalizations semantic in the same sense that human words are semantic? Do animals understand the referential relation that exists between calls and the things for which they stand? Finally, we consider whether monkeys ever use vocalizations to influence another animal's beliefs as well as its behavior.

In this chapter we ask whether the vocalizations used by East African vervet monkeys (*Cercopithecus aethiops*) under natural conditions can usefully be called semantic. Data are drawn from a population of vervets that we and our colleagues studied over a 12-year period in Amboseli National Park,

---

* From: Seyfarth, Robert M. and Dorothy L. Cheney 1993. Meaning, reference and intentionality in the natural vocalizations of monkeys. In: Herbert L. Roitblat, Louis M. Herman, Paul E. Nachtigall (eds.). *Language and Communication: Comparative Perspectives*, 195–219. Hillsdale, N.J: Lawrence Erlbaum Associates. Copyright © 1993 Lawrence Erlbaum Associates. Reproduced by permission of Taylor and Francis. Original figures are not reproduced.

Kenya (Cheney & Seyfarth, 1990a). Additional data, supplementing those on vervet monkeys, come from experiments recently conducted on captive rhesus (*Macaca mulatta*) and Japanese macaques (*M. fuscata*) housed at the California Primate Research Center, University of California, Davis (Cheney & Seyfarth, 1990b).

Subjects

Vervet monkeys in Amboseli National Park live in stable social groups composed of a number of adult males, adult females, and their juvenile and infant offspring. Each group occupies a territory that averages around 0.3 km^2 in size. Territories remain relatively stable from one year to the next and are aggressively defended against incursion by the members of other vervet groups.

As in most Old World monkey species, female vervets remain throughout their lives in the groups where they were born, maintaining close social bonds with female kin through frequent grooming, proximity, and the formation of alliances. Males, in contrast, leave their natal group at around sexual maturity and join a neighboring group, often in the company of brothers or natal group peers. Within each group, males and females can be ranked in linear dominance hierarchies that accurately predict the outcome of competitive interactions over access to food, water, and social companions. Offspring acquire dominance ranks immediately below those of their mothers, such that all members of a family share adjacent ranks (Cheney & Seyfarth, 1990a).

In the wild, group composition, patterns of dispersal, and social behavior among rhesus and Japanese macaques are similar to those among vervet monkeys (e.g., Lindburg, 1971; Sade, 1972; Kawai, 1958; reviewed in Melnick & Pearl, 1987). At the California Primate Research Center, rhesus and Japanese macaques are housed in groups that retain many of the features of each species' natural social organization. Each of the four groups used in our research (two of each species) lived in an outdoor enclosure constructed from two modified corncribs (hereafter called "arenas") connected by an intercage unit. Each group was composed of one or two sexually mature males, three to five sexually mature females, and the females' juvenile and infant offspring. In each group at least two adult females were close genetic relatives (mother and daughter or half-sisters). One rhesus group had been constituted in 1984; animals in the three other groups had lived together for at least 10 years.

Semanticity in the Weakest Sense

There are at least three senses in which an animal vocalization might be called semantic. In the weakest sense, we can describe an animal vocalization as semantic whenever different calls signal the presence of different external objects or events, and when each call elicits the same response as would its referent even when the referent itself is absent (see, for example, Hockett, 1966).

As an example, consider the alarm calls given by vervet monkeys to different sorts of predator. In East Africa, vervet monkeys give acoustically different alarm calls to at least three different predators (Struhsaker, 1967): leopards (*Panthera pardus*), eagles (the martial eagle, *Polemaetus bellicosus* and the crowned eagle, *Stephanoaetus coronatus*), and snakes (usually the python, *Python sebae*). Each alarm call type [...] elicits a different, apparently adaptive response from other monkeys nearby. When vervets are on the ground a leopard alarm causes them to run into trees, where they are safe from a leopard's attack. Eagle alarm calls cause them to look up in the air or run into bushes; when the monkeys are in trees, eagle alarms often cause them to run out of trees and into bushes on the ground (martial and crowned eagles can capture vervets when the monkeys are in trees). Finally, snake alarms cause the monkeys to stand on their hind legs and peer into the grass around them (Struhsaker, 1967). Subsequent experiments have shown that alarm calls alone, even in the absence of an actual predator, elicit the same responses (Seyfarth, Cheney & Marler, 1980). Thus each alarm call type accurately replaces (i.e., elicits the same response as) the object for which it stands, even when that object is not itself present.

The behavior of young vervets provides further evidence that monkeys may be using alarm calls to denote particular predators. When an infant vervet first begins giving alarm calls, he gives alarms to many species, small hawks or pigeons, for example, that do not prey on monkeys and pose no danger to him. Such "mistakes" by infants, however, are not entirely random. Infants give leopard alarms only to terrestrial mammals, eagle alarms only to birds, and snake alarms only to long, snake-like objects [...]. As they grow older, infants and juveniles increasingly restrict their leopard, eagle, and snake alarm calls to the few species within each broad category that actually prey on vervet monkeys (Seyfarth & Cheney, 1980, 1986).

The behavior of infant vervets recalls similar behavior by human infants, who for a brief period during development may overgeneralize the meaning of a word, saying "dadoo" to refer to any male person or "ball" when pointing to any round object (e.g., de Villiers & de Villiers, 1978). And, just as the human child's behavior helps us understand what she has in mind and shows that meaning is not always the same for children and adults, the infant vervet's behavior suggests that the monkeys have some particular class of objects in mind when they use their different alarm calls.

There are at least two alternatives to this "semantic" interpretation of vervet monkey alarm calls. The first (e.g., Marshall, 1970) argues that each call type does not denote a different predator but instead reflects different levels of fear and excitement. In our experiments, however, variation in the length and amplitude of alarm calls, assumed to mimic variation in the caller's emotional state, had little apparent effect on the responses each call elicited from other monkeys (Seyfarth, Cheney, & Marler, 1980).

A second alternative hypothesis (e.g., Smith, 1977, 1981) suggests that different alarm calls do not denote different predators but instead signal what the caller is likely to do next. Of course, given the close link between predator type, alarm call type, and the most appropriate escape response, there will inevitably be a predictable relationship between a specific call and the signaler's subsequent behavior. In itself, however, this does not rule out the possibility that vocalizations also serve a referential function. Recall, for example, that vervet eagle alarm calls can elicit a number of different responses. Animals on the ground may look up or run into a bush, while animals in a tree may run down from the tree; in either circumstance a listener can also do nothing. Moreover, vervets in a tree may run down from a tree even when the caller himself is on the ground and is responding by looking up. In this case, the most parsimonious explanation would seem to be that calls denote a type or class of danger rather than the caller's behavior, and that an individual's particular circumstances strongly influence the exact nature of its response (Seyfarth & Cheney, 1990).

Given these results, we have called the alarm calls of vervet monkeys semantic signals in order to emphasize that, contrary to earlier interpretations, vervet alarms do not simply reflect different levels of excitement or provide information solely about what the caller will do next. Instead, they function to denote objects in the environment in a manner that is at least to some degree independent of the caller's behavior. Of course, this is not to say that information about external referents is the only information conveyed by the vervets' vocalizations. Features such as alarm call amplitude, length, rate of delivery, and the number of individuals calling almost certainly provide listeners with information about how close a predator is and whether it poses immediate danger (e.g., Owings & Hennessy, 1984). Moreover, our understanding of a call's meaning will almost certainly be enriched as we learn more about the acoustic features correlated with a caller's level of motivation or arousal (e.g., Marler, Evans, & Hauser, in press). We emphasize the importance of external referents, in other words, not to minimize the role of emotion or the caller's subsequent behavior as determinants of call meaning, but instead to suggest that the communication of monkeys, long known to be highly expressive, can be denotative as well.

Our definition of semanticity is limited, however, because it is based exclusively on what animals do in the wild and makes no reference to the mechanisms that underlie their behavior. From the data reviewed thus far we can conclude that vervet monkeys behave as if their calls, like some words, denote objects and events in the environment, but we cannot say whether vervets understand the referential relation that exists between their calls and features of the environment, or whether vervets, in responding to another animal's alarm call, interpret this vocalization as a representation of the caller's knowledge. As a result, we cannot say whether the parallel between vervet monkey alarm calls and human words is anything more than a superficial resemblance.

Semanticity in a Stronger Sense

Suppose, however, we adopt a stronger definition of semanticity and argue that an animal's vocalization is semantic only if an individual, given the opportunity to compare two calls, judges them to be the same or different on the basis not just of their acoustic properties but of what they denote. This sort of classification happens so often in language that we take it for granted. When we are asked, for example, to compare two words like "treachery" and "deceit" we judge them to be roughly the same because they refer to the same thing even though their acoustic properties are quite different. By contrast, when asked to compare two words like "treachery" and "lechery" we judge them to be different even though their acoustic properties are very similar.

The "ape language" projects provide a number of elegant cases in which animals have learned to assess and compare signs according to their meaning. To cite just one example, Premack (1970, 1976) used an artificial lexicon of plastic chips to study communication and intelligence in chimpanzees. His most famous subject was an adult female, Sarah. To test whether Sarah really understood the meaning of her symbols, Premack first asked her to describe the features of an actual apple. Was it red? Was it round? Did it have a stem? Then Sarah was asked the same questions about the Symbol for apple, in this case a blue triangle. She described the blue triangle as being red, round, and having a stem. Premack then reversed the question and asked Sarah to begin with an object and describe properties of the name for that object. Shown an apple, Sarah correctly answered that the sign for this object was triangular not round, blue not green, and small not big.

To test whether vervet monkeys also assess vocalizations according to the things for which they stand, we designed a series of experiments in which subjects were asked to compare two calls with different acoustic properties. In some tests the calls referred to similar objects or events; in other tests their referents were different. If vervets compare vocalizations, that is, make a same/different judgment between them, on the basis of their referents, subjects should have judged two calls as "same" even when the calls were acoustically different. By contrast, calls with different referents should always have been judged as "different".

In one series of experiments, we used as stimuli two different calls given by female and juvenile vervets to members of other groups: a short, staccato chutter and a wrr, a long, loud trilling call. Although the two calls are acoustically quite different [...], each occurs only in the presence of another group (Struhsaker, 1967; Cheney & Seyfarth, 1982). Wrrs are usually given when a neighboring group has first been spotted, and they seem to function to alert other animals to the proximity of another group. Roughly 45% of all intergroup encounters involve only the exchange of wrrs (Cheney, 1981). Other encounters, however, escalate into aggressive threats, chases, and even physical contact. When groups come together under these conditions, females and juveniles often give the acoustically different chutter vocalization (Cheney & Seyfarth, 1988).

Although wrrs and chutter are acoustically distinct, they have broadly similar referents. To test whether subjects compare vocalizations according to their acoustic properties or their referents, we designed experiments in which a subject would repeatedly hear animal X's wrr when there was no other group present. Under these conditions, when the subject had habituated to X's wrr, we played animal X's chutter to see if she had also habituated to this acoustically different vocalization. If the two calls have similar meanings, and if monkeys use meaning to judge the relationship between calls, habituation to X's repeated wrrs should also produce habituation to X's chutter. Alternatively, if monkeys use some other feature (like the calls' acoustic properties) to judge similarity or difference between calls, these features, and not the calls' referents, should determine whether habituation is transferred from X's wrr to X's chutter.

In conducting our experiments, we borrowed a method that has been used successfully in research on preverbal human infants (e.g., Eimas, Siqueland, Jusczyk, & Vigorito, 1971). On day 1, as a control, a subject was played a particular female's chutter in order to establish the baseline strength of the subject's response to this vocalization. Then, on day 2, the subject heard the same female's wrr repeated eight times at roughly 20-min intervals. We measured subjects' responses and found that they did, in fact, habituate. Finally, roughly 20 min after the last playback in the habituation series, the subject heard the same female's chutter again (the test condition). The magnitude of the decrement in response between control and test conditions measured the extent to which subjects judged the habituating and test stimuli to be the same: a large decrement indicated that subjects regarded the two calls as similar; little or no decrement indicated that the calls were different.

Since vervets and other primates take note of the signaler's identity when attending to calls (e.g., Hansen, 1976; Cheney & Seyfarth, 1980), we also wanted to determine whether subjects would transfer habituation from one individual to another. Hence in a second series of experiments we varied our procedure by playing two different individuals' calls. On day 1, we established baseline data on the strength of a subject's response to individual Y's chutter. Then, on day 2, we played X's wrr to the subject eight times. After the subject had habituated to X's wrr we then tested to see if she had also habituated to Y's chutter.

A third test examined whether vervets would also transfer habituation if the identity of the signaler remained the same but the call's *referent* was changed. We therefore repeated the procedure described for the first set of experiments but now, instead of wrrs and chutters, we used leopard and eagle alarm calls as stimuli.

Results provided clear evidence that vervet monkeys compare different calls on the basis of their meaning and not just their acoustic properties. In all experiments, subjects rapidly habituated to repeated presentation of the same vocalization. When they were presented with the same individual's wrr and chutter, two acoustically different calls with roughly the same referent, they transferred habituation across different call types [...]. In other words, if a subject had habituated to animal X's wrr, she also ceased responding to X's intergroup chutter.

By contrast, when subjects were asked to compare two calls whose referents were different, they did not transfer habituation across call types [...]. If a subject had ceased responding to X's leopard alarm call, she nevertheless still responded at normal strength to X's eagle alarm.

Habituation was also not transferred when the calls had the same referent but were given by two different individuals. Even if a subject had ceased responding to individual X's wrr, individual Y's chutter still elicited the same response as it had under normal conditions (see Cheney & Seyfarth, 1988, for details of this and further experiments).

Compared with our earlier research on the vervets' alarm calls, these tests address the question of meaning and reference more directly, by asking animals to compare two vocalizations and to reveal the criteria they use in making their comparison. Like humans (e.g., Yates & Tule, 1979), vervet monkeys appear to process vocalizations according to an abstraction—their meaning—and not just according to acoustic similarity. The fact that subjects failed to transfer habituation when played the calls of two different individuals suggests that they took into account both the signal's meaning and the signaler's identity when attending to a call.

For further evidence that vervet monkeys make judgments about vocalizations according to the objects and events they denote, consider the monkeys' responses to the alarm calls of a sympatric bird, the superb starling (*Spreo superbus*). Like vervets, starlings have at least two distinct alarm calls, neither of which bears any acoustic resemblance to the vervets' own alarms. One starling alarm, a harsh, noisy chatter, is given to a variety of terrestrial predators. The second, a clear rising or falling tone, is given to hawks and eagles that attack from the air.

Vervet monkeys appear to recognize the difference between these calls, because they respond differently to each. When we carried out playback experiments using starling terrestrial predator alarms, starling raptor alarms, and starling song as stimuli, monkeys responded by running toward trees when they heard terrestrial predator alarms and looking up when they heard raptor alarms. By contrast, the monkeys showed no particular response when they heard the starlings' song (Cheney & Seyfarth, 1985).

As noted earlier, however, such playbacks say nothing about the mechanisms that underlie the vervets' discrimination among different alarm call types. To investigate such mechanisms in more detail, we once again used a habituation/dishabituation paradigm that asked subjects to compare two vocalizations. We reasoned that if vervet monkeys not only distinguish between the starling's different alarm calls but also classify starling alarms according to the types of predator they denote, then subjects should transfer habituation from the alarm calls of one species to the alarm calls of another provided the calls have the same referent. For example, vervets who have habituated to the raptor alarm calls of starlings should cease responding to the raptor alarms of vervets, and vice versa. By contrast, subjects who have habituated to one species' terrestrial predator alarm should not transfer habituation to the other species' raptor alarm.

Once again, results suggested that vervet monkeys assess and compare vocalizations according to the calls' meaning and not just their acoustic properties. For example, when subjects had habituated to repeated presentation of a vervet's (or starling's) raptor alarm call, they transferred habituation to the raptor alarm of the other species [...]. The monkeys behaved as if vervet eagle alarms and starling raptor alarms, despite their different acoustic properties, were in at least one respect similar to one another. In contrast, when subjects were asked to compare starling raptor alarm calls with vervet leopard alarms [...], no transfer of habituation occurred (for further details and results of other tests, see Seyfarth & Cheney, 1990).

This, of course, makes perfectly good biological sense. Given the high rates of predation in the vervets' environment (Cheney & Seyfarth, 1990a), there is every reason for them to have learned that sympatric species like starlings can be just as effective as other vervets in warning of an imminent attack. At the same time, it is interesting to note that when the monkeys were asked to compare two of their own species' vocalizations (wrrs and chutters), caller identity played an important role in the assessment of call meaning. By contrast, when the monkeys made a comparison that involved the calls of another species, caller identity seemed less important.

Taken together, the results of experiments using wrrs, chutters, vervet alarm calls, and starling alarm calls are difficult to explain without assuming that monkeys have some representation of the objects and events denoted by different call types and that they compare and respond to vocalizations on the basis of these representations. Apparently, when one monkey hears another monkey (or even a nearby bird) vocalize, the monkey forms a representation of what that call means. And if, shortly thereafter, the monkey hears a second vocalization, the two calls are compared on the basis of their representations, not just their physical similarity.

This is not to say that monkeys are necessarily aware of the distinction between signs and the objects they denote, or aware of their ability to compare vocalizations according to their referents. We cannot assume that an individual who can make same/different judgments about two calls on a habituation test will be able to make conscious use of this distinction in his daily life. Indeed, there is evidence that infant chimpanzees that can perceive a relational distinction when tested with an habituation procedure are nevertheless unable to apply their apparent knowledge of this distinction in a match-to-sample test (Oden, Thompson, & Premack, 1988). Habituation data alone, therefore, do not prove that monkeys understand the relation *wrr denotes another group* or *eagle alarm denotes an eagle* in the same way that a chimpanzee understands the relation *blue triangle means apple.*

Semanticity in the Strongest Sense

Human language involves more than just a recognition of the referential relation between words and the objects or events they denote. When communicating with one another we also attribute mental states like knowledge, beliefs, or desires to others, and we recognize that there is a causal relation between mental states and behavior: what an individual thinks influences what he does. Similarly, as listeners we interpret words not only as signs for things but also as representations of the speaker's knowledge. We are, moreover, acutely sensitive to the relation between words and the mental states that underlie them. If we detect a mismatch between what another person says and what he thinks, we immediately consider the possibility that he is trying to deceive us.

Human language thus provides us with a definition of semanticity in its strongest sense. Having shown that monkeys make judgments about vocalizations based on their referents, we now consider whether animals ever attribute mental states to one another, know that these mental states can affect behavior, and as a result vocalize not only to influence what other animals do but also to influence what they think.

To attribute beliefs, knowledge, or ignorance to another individual is to have what Premack and Woodruff (1978) term a *theory of mind*. A theory of mind is a theory because, unlike behavior, mental states are not directly observable, although they can be used to make predictions about behavior. Many animals are adept at monitoring each other's behavior. What is not known is whether they are equally adept at monitoring each other's states of mind (see discussion by Dennett, 1987). To cite just one example, the alarm calls of many birds and mammals are not obligatory, but depend on social context. Individuals often fail to give alarm calls when there is no functional advantage to be gained by alerting others—for instance, when they are alone or in the presence of unrelated individuals (e.g., ground squirrels, Sherman, 1977; downy woodpeckers, Sullivan, 1985; vervet monkeys, Cheney & Seyfarth, 1985; roosters, Gyger, Karakashian, & Marler, 1986). However, while this audience effect clearly requires that a signaler monitor the presence and behavior of group companions, it does not demand that the signaler also distinguish between ignorance and knowledge on the part of his audience. Indeed, in all species studied thus far, signalers call regardless of whether or not their audience is already aware of danger. Vervet monkeys, for example, will continue to give alarm calls long after everyone in their group has seen the predator and retreated to safety (for further discussion see Cheney & Seyfarth, 1990a).

According to Grice (1957), true communication does not occur unless both signaler and recipient take into account each other's states of mind. By this criterion (from which we derive the definition of semanticity in its strongest sense), it is highly doubtful that any animal signal could ever be described as truly communicative. Does this matter, though? It could easily be argued that there is little selective advantage to be gained from determining whether or not one's audience is ignorant or knowledgeable before uttering an alarm call; as long as the call functions to inform others of danger, the audience's state of mind is irrelevant. In at least some species, however, individuals who give alarm calls put themselves at greater risk than those who remain silent, because their alarm calls attract the attention of predators (see, e.g., Sherman, 1977, 1985 for ground squirrels). Under these conditions, an individual would be at an advantage if he could determine whether or not an alarm call was necessary before giving a vocalization.

Pedagogy as Evidence for a Theory of Mind

An individual who cannot recognize the difference between his own and another individual's knowledge and beliefs will be incapable of selectively teaching or informing others of information that he possesses, simply because he will be unable to recognize ignorance in others. There is very little evidence, however, that the behavior of monkeys is ever influenced by other individuals' states of mind. Consider, for example, the development of antipredator behavior in young vervet monkeys. As noted earlier, when infant vervets first begin giving alarm calls they often make "mistakes," giving alarm calls to species like vultures or storks that pose no danger to them. Adults nonetheless respond to infant alarm calls, albeit in some cases quite briefly. For example, if an infant gives an eagle alarm in response to a pigeon, adults will look up and then quickly go back to what they were doing. By contrast, if an infant is the first member of his group to give an eagle alarm in response to a genuine predator (a martial or crowned eagle), adults will look up and then give an alarm call themselves (Seyfarth & Cheney, 1986). At first glance these "second alarms" by adults seem to be explicitly instructive, because they reinforce the infant's behavior when it is correct. Adults, however, are no more likely to give second alarms after correct alarm calls by infants than they are after correct alarm calls by other adults. Even though infants make many more errors than adults, adults make no special effort to reward them when they are correct. We would expect such special efforts if adults attributed ignorance to infants.

A similar picture emerges when we consider infants' responses to alarm calls. Here again, young infants make many mistakes. When we played tape-recorded alarm calls to infants younger than 6-months of age, adult-like responses were rare. Instead, infants either ran toward their mothers or responded in a way that actually increased their vulnerability to predation. An infant, for example, might look up when he heard a snake alarm or run into a bush when he heard a leopard alarm (Seyfarth & Cheney, 1986). In analyzing the responses of infants and mothers to playbacks of alarm calls, we looked carefully to see whether an infant's behavior affected what his mother did—whether, in this respect, mothers ever corrected their infants' errors. We found no such evidence.

In both of these cases, the vervets' behavior draws our attention to the distinction between active pedagogy and more passive observational learning. Perhaps because adult monkeys do not recognize the difference between what they know and what an infant knows, adults do not go out of their way to instruct infants about predators and the proper response to alarm calls. As a result, infants are left to learn by observation, which is a much slower and less efficient way to transmit information.

Informing as Evidence for a Theory of Mind

As a more direct test to determine whether monkey mothers ever modify their behavior depending on their offspring's knowledge, we carried out a series of experiments on two groups of rhesus and two groups of Japanese macaques. In captivity, both rhesus and Japanese macaques often give alarm calls when they see technician carrying nets, and they also give coo-like food calls when they are fed preferred foods like fruit (personal observation; Green, 1975).

We began each trial by locking all but two members of a given group into one of the cage's arenas. The two remaining animals, a mother and her juvenile offspring, were locked in the intercage unit at the edge of the other arena. In the "knowledgeable" condition, mother and offspring were seated next to each other. Each could see the other and both could see the empty test arena. In one set of trials, both individuals then watched a human place a highly preferred food (apple slices) in a food bin in the test arena. After observing the placement of food, the offspring, but not the mother, was released into the test arena where it had access to the food bin.

In the "ignorant" condition, mother and offspring were again locked in the intercage unit, but the offspring was seated some distance from the mother, visually isolated and physically separated from her by a steel partition. Now only the mother could see the apple slices being placed in the food bin. After the food had been placed in the bin, the offspring, but not the mother, was once again released into the arena.

In a second set of trials, mothers were presented with a "predator" in the form of a technician wearing a surgical mask and brandishing a net as if to capture her. After 10 s of exposure, the technician hid behind a barrier next to the test arena. In the "knowledgeable" condition the mother was seated next to her offspring so that both mother and offspring saw the technician. In the ignorant condition, as before, the offspring was separated from the mother behind a steel partition and only the mother could see the technician. In both conditions, the offspring was released into the test arena immediately after the technician had disappeared.

If monkeys are sensitive to the mental states of others, that is, if they take their audience's knowledge into account when giving food or alarm calls, the mothers should have uttered more calls (or in some other way have altered their behavior) when their offspring were ignorant than when they were already informed. On the other hand, if informants are unaffected by their audience's mental states, the mothers' behavior should have been similar regardless of whether or not their audience had also seen the food or danger.

In both experiments the mothers' behavior seemed unaffected by their offspring's knowledge. In the food experiments, mothers and offspring did exchange vocalizations at low rates, but there was no difference in calling rate between mothers whose offspring were knowledgeable and those whose offspring were ignorant. In the predator experiments, mothers did not alarm call at higher rates when their offspring were ignorant, nor did they orient toward or look at their offspring more when the offspring were ignorant than when the offspring had also observed the predator (Cheney & Seyfarth, 1990b).

In each experiment, the mothers' apparent failure to communicate information to their ignorant offspring had measurable consequences. In the food experiments, the mean latency for finding and eating food was significantly shorter for knowledgeable offspring than for ignorant ones [...]. In other words, even though mothers had ample opportunity to recognize a mismatch between their own knowledge and that of their offspring, they took no apparent steps to redress this imbalance—for example, by giving coo vocalizations while looking at the food bin. In the predator experiments, offspring who knew the technician was present spent significantly more time sitting huddled near the barrier separating them from their mothers than did ignorant offspring, who were more likely to wander around the cage [...]. Once again, the primary factor in the amount of anxiety shown by offspring was their own knowledge, and not their mothers'.

Of course, these negative results do not allow us to distinguish between the inability to attribute states of mind to others and the failure of this ability to alter behavior. It is certainly possible that monkeys do recognize the difference between their own knowledge and the knowledge of others, but that their behavior is simply unaffected by this knowledge. Whenever knowledge in another species is defined operationally, through behavior, there is a danger of concluding that an ability is absent when it is simply not manifested. Negative results are of interest, however, when compared with information transmission in humans. Although human cultures vary in their emphasis on active informing and pedagogy (see, e.g., Boyd & Richerson, 1985), in no culture are these modes of transmission absent. In contrast, pedagogy has yet to be documented conclusively in any nonhuman primate species, including chimpanzees (for reviews see Cheney & Seyfarth, 1990a; Visalberghi & Fragaszy, 1990). Even if nonhuman primates are capable of distinguishing ignorance and false beliefs in others, therefore, their apparent failure to act on this knowledge is striking.

Summary

Vervet monkey vocalizations qualify as semantic signals in the weak sense that they provide listeners with information about objects and events in the environment. Vervet calls are also semantic in the stronger sense that their production and interpretation depend on the mental states of both signaler and recipient. For example, when monkeys in habituation experiments are asked to compare two vocalizations, they do so not just according to the calls' acoustic properties but also according to their referents. To a vervet, the world is composed of two fundamentally different sorts of things: objects, such as leopards, snakes, or other groups; and vocalizations, which serve as representations of these objects. Monkeys respond to objects according to their physical features; they respond to vocalizations according to the things for which they stand.

Although vocalizations are semantic in this stronger sense, the calls of vervets and other monkeys seem not to be semantic in the strongest sense of being given with an intent to modify the mental states of listeners, or to draw listeners' attention to the signaler's own mental state. Adult monkeys, for example, make no special effort to correct infants that use and respond to vocalizations incorrectly. Similarly, there is no evidence that adults distinguish between juveniles that are unaware of food or danger and those that already know that food and danger are present. We suggest that monkeys cannot communicate with an intent to modify the mental states of others because they do not recognize that such mental states exist.

Acknowledgments

Research supported by NSF grant 85-21147 and NIH grant NS 19826. We thank the Office of the President, Republic of Kenya for permission to conduct research in Amboseli National Park; A. Hendrickx and W. A. Mason for support and administrative assistance at the California Primate Research Center; and C. T. Snowdon, R. K. R. Thompson, M. D. Hauser, and Peter Marler for comments an the manuscript.

References

Boyd, R. and P. Richerson
1985 *Culture and the evolutionary process.* Chicago: University of Chicago Press.

Cheney, D. L.
1981 Intergroup encounters among free-ranging vervet monkeys. *Folio Primatologica, 35*, 124-146.

Cheney, D. L. and R. M. Seyfarth
1980 Vocal recognition in free-ranging vervet monkeys. *Animal Behaviour, 28*, 362-367.

Cheney, D. L. and R. M. Seyfarth
1982 How vervet monkeys perceive their grunts: Field playback experiments. *Animal Behaviour, 30*, 739-751.

Cheney, D. L. and R. M. Seyfarth
1985 Social and nonsocial knowledge in vervet monkeys. In L. Weiskrantz (ed.), *Animal intelligente* (pp. 187–201). Oxford: Clarendon Press.

Cheney, D. L. and R. M. Seyfarth
1988 Assessment of meaning and the detection of unreliable signals by vervet monkeys. *Animal Behaviour, 36*, 477-486.

Cheney, D. L. and R. M. Seyfarth
1990a *How monkeys see the world: Inside the mind of another species*. Chicago: University of Chicago Press.

Cheney, D. L. and R. M. Seyfarth
1990b Attending to behaviour versus attending to knowledge: examining monkeys' attribution of mental states. *Animal Behaviour*, 40, 747–753.

Dennett, D. C.
1987 *The intentional stante.* Cambridge, MA: MIT Press/Bradford Books.

Eimas, P. D., P. Siqueland, P. Jusczyk, and J. Vigorito, J.
1971 Speech perception in infants. *Science*, 171, 303–306.

Green, S.
1975 Communication by a graded vocal system in Japanese monkeys. In: L. A. Rosenblum (ed.), *Primate Behavior* (*Vol.* 4, pp. 1–102), New York: Academic Press.

Grice, H. P.
1957 Meaning. *Philosophical Review*, 66, 377–388.

Gyger, M., S. J. Karakashian, and P. Marler
1986 Avian alarm-calling: Is there an audience effect? *Animal Behavior*, 34, 1570–1572.

Hansen, E. W.
1976 Selective responding by recently separated juvenile rhesus monkeys to the calls of their mothers. *Developmental Psychobiology*, 9, 83–88.

Hockett, C. F.
1966 Logical considerations in the study of animal communication. In: W. E. Lanyon & W. N. Tavolga (eds.), *Animal sounds and communication* (pp. 390–430). Washington: American Institute of Biological Sciences.

Kawai, M.
1958 On the system of social ranks in a natural group of Japanese monkeys. *Primates* 1, 11–48.

Lindburg, D. G.
1971 The rhesus monkey in northern India: An ecological and behavioral study. In: L. A. Rosenblum (ed.), *Primate Behavior* (Vol. 2, pp. 1–106). New York: Academic Press.

Marshall, J. C.
1970 The biology of communication in man and animals. In: J. Lyons (ed.), *New Horizons in Linguistics* (pp. 229–241). Harmondsworth, U.K.: Penguin.

Melnick, D. and M. C. Pearl
1987 Cercopithecines in multimale groups: Genetic diversity and population structure. In: B. Smuts, D. L. Cheney, R M. Seyfarth, R. W. Wrangham & T. T. Struhsaker (eds.), *Primate Societies* (pp. 121–134). Chicago: University of Chicago Press.

Oden, D. L., R. K. R. Thompson, and D. Premack
1988 Spontaneous transfer of matching by infant chimpanzees (*Pan troglodytes*). *Journal of Experimental Psychology: Animal Behavior Processes*, 14, 140–145.

Owings, D. and D. Hennessy
1984 The importance of variation in sciurid visual and vocal communication. In: J. 0. Murie & G. R. Michener (eds.), *Biology of ground dwelling squirrels: Annual cycles, behavioral ecology, and sociality* (pp. 169–200). Lincoln: University of Nebraska Press.

Premack, D.
1970 A functional analysis of language. *Journal of the Experimental Analysis of Behavior*, 14, 104–125.

Premack, D.
(1976 *Intelligence in ape and man.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Premack, D. and C. Woodruff
1978 Does the chimpanzee have a theory of mind? *Behavioral and Brain sciences, 1*, 515–526.

Sade, D. S.
1972 A longitudinal study of social behavior of rhesus monkeys. In: R. H. Tuttle (ed.), *The functional and evolutionary biology of primates* (pp. 378–398). Chicago: Aldine Publishing Co.

Seyfarth, R. M. and D. L. Cheney
1980 The ontogeny of vervet monkey alarm calling behavior: A preliminary report. *Zeitschrift fur Tierpsychologie*, 54, 37–56.

Seyfarth, R. M. and D. L. Cheney
1986 Vocal development in vervet monkeys. *Animal Behavior*, 34, 1640–1658.

Seyfarth, R. M. and D. L. Cheney
1990 The assessment by vervet monkeys of their own and another species' alarm calls. *Animal Behaviour*, 38, 754–764.

Seyfarth, R. M., D. L. Cheney, and P. Marler
1980 Vervet monkey alarm calls: Semantic communication in a free-ranging primate. *Animal Behavior* 28, 1070–1094.

Sherman, P. W.
1977 Nepotism and the evolution of alarm calls. *Science*, 197, 1246–1253.

Sherman, P. W.
1985 Alarm calls of Belding's ground squirrels to aerial predators: Nepotism or seif-preservation? *Behavioural Ecology & Sociobiology, 17*, 313–323.

Smith, W. J.
1977 *The behavior of communicating.* Cambridge, MA: Harvard University Press.

Smith, W. J.
1981 Referents of animal communication. *Animal Behaviour, 29*, 1273–1275.

Struhsaker, T. T.
1967 Auditory communication among vervet monkeys (*Cercopithecus aethiops*). In: S. A. Altman (ed.), *Social communication among primates* (pp. 281–324). Chicago: University of Chicago Press.

Sullivan, K.
1985 Selective alarm-calling by downy woodpeckers in mixed-species flocks. *Auk*, 102, 184–187.

de Villiers, J. G. and P. A. de Villiers
1978 *Language acquisition.* Cambridge, MA: Harvard University Press.

Visalberghi, E. and D. M. Fragaszy
1990 Do monkeys ape? In: S. T. Parker & K. R. Gibson (eds.), *"Language" and intelligence in monkeys and apes* (pp. 247–273). Cambridge: Cambridge University Press.

Yates, J. and N. Tule
1979 Perceiving surprising words in an unattended auditory channel. *Quarterly Journal of Experimental Psychology*, 31, 281–286.

Intentional Communication and Social Play: How and Why Animals Negotiate and Agree to Play*

Marc Bekoff and Colin Allen

Social Play: Evolution, Pretense, and the Cognitive Turn

> To return to our immediate subject: the lower animals, like man, manifestly feel pleasure and pain, happiness and misery. Happiness is never better exhibited than by young animals, such as puppies, kittens, lambs, etc., when playing together, like our own children. Even insects play together, as has been described by that excellent observer, P. Huber, who saw ants chasing and pretending to bite each other, like so many puppies. (*Charles Darwin 1871/1936, p. 448*)

Pierre Huber (1810, p. 148), in his book about the behavior of ants, claims that if one were not accustomed to treating insects as machines one would have trouble explaining the social behavior of ants and bees without attributing emotions to them. Although we shall skirt the issue of emotion, many observers would agree that animals play because it is fun for them to do so. But even if the issue of emotions is set aside, readers conditioned by the scruples of modern psychology are likely to be skeptical of Darwin's ready acceptance that Huber observed ants playing. Play, as the quotation above indicates, seems to involve pretense, and pretense is commonly thought to require more sophisticated intentions than are usually attributed to ants. How could Huber have seen or inferred pretense from the behavior of the ants? And how could he be sure that the observed behavior was not, in fact, directed toward some very specific and immediate function? These questions raise the difficult issue of what play is, or, as biologists are wont to put it, how to define 'play'. This issue has proven a great challenge to those who study this interesting behavioral phenotype.

We and others believe that social play is a tractable, evolved behavioral phenotype that lends itself to detailed empirical study. And, the flexibility and ver-

---

* From: Bekoff, Marc and Colin Allen 1998. Intentional communication and social play: How and why animals negotiate and agree to play. In: Marc Bekoff, John A. Byers (eds.) *Animal Play: Evolutionary, Comparative, and Ecological Perspectives*, 97–114. Cambridge: Cambridge University Press. 1998 © Cambridge University Press, reproduced with permission.

satility of social play makes it a good candidate for comparative and evolutionary cognitive studies including those that center on ways in which animals might negotiate agreements to engage in a cooperative social interaction. As such, cognitive ethological approaches are useful for gaining an understanding of the social play behavior of diverse animals for a number of reasons (Jamieson & Bekoff 1993; Bekoff 1995 a,b; Allen & Bekoff 1997; Bekoff 1998). First, empirical research on social play has benefited and will further benefit from a cognitive approach because play involves issues of communication, intention, role playing and cooperation. Second, many believe that detailed analysis of social play may provide more promising evidence of animal minds than research in many other areas, for it may yield clues about the ability of animals to understand each other's intentions. Third, play is a phenomenon that occurs in a wide range of mammalian species and a number of avian species. Thus it affords the opportunity for a comparative investigation of cognitive abilities extending beyond the all-too-common narrow focus on primates that dominates discussions of nonhuman cognition. Thus, the topic of social play exemplifies many of the theoretical issues faced by cognitive ethologists and may help those who are interested in broadening the evolutionary study of animal cognition.

The study of social play provides an opportunity to pursue the suggestion by Niko Tinbergen (1972) and others (Schaller & Lowther 1969) that we may learn as much or more about human social behavior by studying social carnivores as by studying nonhuman primates. Byrne (1995), who otherwise takes a strongly primatocentric view of animal cognition, observed that we might learn more about the phylogenetic distribution of what he calls intelligence by doing comparative research. Furthermore, Povinelli & Cant (1995) suggest that the performance by arboreal ancestors of the great ape/human clade of 'unusual locomotor solutions… drove the evolution of self-conception' (p. 400). Many nonprimate mammals also perform complex, flexible, and unusual acrobatic motor patterns (locomotor-rotational movements) during social play, and it would be premature to rule out the possibility that the performance of these behaviors is also important to the evolution of self-conception in non-primates. In some instances it is difficult to know whether aboreal clambering or the performance of various acrobatic movements during play may more be related to the evolution of (mere) body awareness (e.g. knowing one's place in space) and not a concept of self.

What is Play?

As other papers in this volume show, the term 'play' covers a wide range of behavior patterns. In this respect it is not different from terms such as 'feeding' or 'mating', both of which may encompass a variety of quite different behaviors when comparing members of either the same or different species. However, unlike play, feeding and mating correspond to easily identified biological functions.

Play is not easily defined (Bekoff & Byers 1981; Fagen 1981; Martin & Caro 1985; Burghardt 1998). Attempts to define it functionally face the problem that it is not obvious that play serves any particular function either at the time at which it is performed or later in life. Indeed several authors have been tempted into defining play as functionless behavior. Alternatively it has sometimes been suggested that play serves some general functions such as improving the motor and cognitive skills of young animals, yielding possible payoffs, for example, in the hunting, foraging, or social abilities of these animals from the time of the play throughout their entire lifespans. Even if this is correct, the reproductive fitness consequences of play may typically be so far removed in the life time of the organisms involved that it would be very difficult to collect data to support the assertion that play increases fitness. Furthermore, there may be different possible evolved functions of play depending on the species being studied. It is difficult to design experiments to test hypotheses about functions of play that are both practicable and ethical. Thus play seems to be either functionless or it can be considered as serving different functions for individuals of different species, ages, and sex (Bekoff & Byers 1981; Fagen 1981; Byers & Walker 1995; Burghardt 1996; Watson & Croft 1996).

These considerations led Bekoff & Byers (1981, pp. 300-1; see also Martin & Caro 1985) to eschew a functional characterization of play by offering the following definition: '*Play* is all motor activity performed postnatally that *appears* [our emphasis] to be purposeless, in which motor patterns from other contexts may often be used in modified forms and altered temporal sequencing. If the activity is directed toward another living being it is called *social play.*' This definition centers on the structure of play sequences—what animals do when they play—and not on possible functions of play. Nonetheless the definition is not without problems, for it would seem to apply, for example, to stereotypical behaviors such as the repetitive pacing or excessive self-grooming sometimes evinced by caged animals. It is difficult to see how to state a non-arbitrary restriction on the range of behaviors that may constitute play.

Because it is not easily defined, play, both social and nonsocial, has been a very difficult behavioral phenotype with which to deal rigorously. A few people would claim that only humans engage in play, but most agree that nonhumans play despite finding it difficult to offer an exceptionless definition. But this lack of a comprehensive definition need not be an impediment to conducting solid research. Our view is that the study of play ought to be approached like the study of any other (putative) natural kind of behavior (Allen & Bekoff 1994). To study play, one ought to start with examples of behaviors which superficially appear to form a single category—those that would be initially agreed upon as play—and look for similarities among these examples. If similarities are found, *then* we can ask whether they provide a basis for useful generalizations. We therefore propose to proceed on the basis of an intuitive understanding of play, guided to some extent by Bekoff & Byers' attempt to define it, but without the view that this or any other currently available definition strictly includes or excludes any specific behaviors from the category of play.

Can There Be an Evolutionary Biology of Play? The Possible Problem of Intentionality

Alexander Rosenberg (1990) presents some challenges to an evolutionary approach to social play. One of his concerns hinges on his claim that play is an intentional activity. For reasons similar to those of Dennett (1969) and Stich (1983), and rejected by Allen & Bekoff (1994, 1997), Rosenberg believes that intentional explanations are not suitable for scientific explanations of behavior. Rosenberg, for instance, suggests that it might be inappropriate to attribute the concept of mouse-catching to a cat by asking 'Does it have the concept of mouse, *Mus musculus* in Linnaean terms?' (p. 184). Our view is that possession of the Linnaean concept of a mouse is not a reasonable requirement to be placed on the attribution of beliefs about mouse catching (see Allen & Bekoff 1994).

Rosenberg also argues that there can be no unified evolutionary account of play because actual cases of play have heterogeneous causes and effects, and different underlying mechanisms. He draws an analogy between play and clocks, pointing out that because there are so many different mechanisms that constitute clocks there is no 'single general explanatory theory that really explains what clocks do, how and why they do it.' (p. 180) The problem with this argument is that the kind of 'single general explanatory theory' referred to is not (and should not be) the kind of thing evolutionary biology is necessarily concerned with. While it is the concern of some branches of biology (particularly molecular and cellular) to explain *how* certain organs do what they do, other branches of evolutionary theory are concerned with *what* they do and *why* they do it. So while it would be foolish to expect a singular molecular or cellular account of light-sensing capabilities across species, it is not foolish to expect unity in some aspects of the evolutionary explanations of the development of such organs (although, of course, there will be differences in the evolutionary histories across different species). If Rosenberg was right, there could be no general evolutionary theory of predation or sexual selection by mate choice, for these phenomena too depend on a very heterogeneous set of mechanisms. Play, we submit, is in no worse shape than these well entrenched targets of biological explanation.

Play, Pretense, and Intentionality

> After all, from an evolutionary point of view, there ought to be a high premium on the veridicality of cognitive processes. The perceiving, thinking organism ought, as far as possible, to get things right. Yet pretense flies in the face of this fundamental principle. In pretense we deliberately distort reality. How odd then that this ability is not the sober culmination of intellectual development but instead makes its appearance playfully and precociously at the very beginning of childhood. (*Leslie 1987, p. 412*)

As we noted above, discussions of play commonly refer to the concept of pretense. Because pretense seems to be a fairly sophisticated cognitive ability it has led some authors to deny that nonhuman animals can be said to engage in play. Rosenberg (1990), for example, associates pretense with ‘third-order’ intentionality (Grice 1957; Dennett 1983, 1987). According to Rosenberg, for animal *a* truly to be playing with *h*, it must be that ‘*a* does *d* [the playful act] with the intention of *b's* recognizing that *a* is doing *d* not seriously but playfully. So, *a* wants *h* to believe that *a* wants to do *d* not seriously but with other goals or aims.’ (Rosenberg 1990, p. 184) This is third-order because there are three levels of mental state attribution involved, i.e. *a believes* that *b believes* something about *a*’s *desires.* This requirement might be thought to rule out play not just in nonhuman animals, but also in human infants.

In contrast to this approach, the Bekoff & Byers characterization of play is neutral about the intentionality of play behavior. Ultimately it might be found that play is an intentional activity but it would be premature, in our view, to include this in the definition of play. The relevance of intentionality to play is a matter for empirical investigation, and any empirical investigation of the connection between play and intentionality will be shaped by the account of intentionality that is provided (for discussion see Allen & Bekoff 1997, Chapter 6).

From Dennett’s intentional stance, organisms are modeled as representing various aspects of their environments and their actions are guided by those representations. For some organisms, these representations may themselves contain information about how other organisms represent their environments. Such a representation of a representation is a case of second-order intentionality in Dennett's scheme. Dennett treats higher-order intentionality as cognitively more sophisticated (and therefore more recently evolved) than first-order intentionality (which in turn is more sophisticated than zero-order or non-intentionality). Thus, to place cognitive capacities into an evolutionary framework, he thinks it is important to identify the distribution of higher-order intentionality among animals.

Millikan (1984) provides a contrasting approach to intentionality. According to Millikan's account, intentionality is a *functional* property—attributions of intentionality provide information about the historical role of a particular trait but do not directly explain or predict the operations of that trait. To understand this it is useful to consider a non-intentional example of a functional property: the function of a sperm to penetrate an egg. Even knowing this function, one cannot predict that any particular sperm will penetrate an egg—it is far more likely that it will not. Likewise, in intentional cases, one cannot predict that any particular organism will act in a way that is rationally predicted by attributing a state with intentional content. While it may be a function of that intentional state to produce the behavior, there is no more guarantee that a state such as a belief or a desire will fulfill its function than there is that a sperm will penetrate an egg. (See Bekoff & Allen 1992 for a discussion of why Millikan's theory is useful for informing and motivating studies in cognitive ethology.)

Different theories of intentionality have different consequences for specifying the contents of intentional states. Consider Dennett's intentional stance first. To attribute a belief in the conjunction of P and Q entails the attribution of the belief that Q for it would be irrational to fail to infer Q from the conjunction. Attributing this (rather minimal) rationality to subjects thus seems to entail that any subject capable of believing a conjunction must also be capable of believing each conjunct separately. But in Millikan's framework it is quite possible to have an intentional icon whose function it is to map onto the conjunction of P and Q *without* the system having either the ability or the tendency to represent the singular Q. Imagine, for example, a system whose Q-detector only becomes operative once its P-detector registers an occurrence of P. Such a system would be capable of representing the conjunction of P and Q without being able to represent Q alone. Perhaps, because Q rarely occurs in isolation, or when it does its occurrence is normally irrelevant to the organism, it was never important for the members of the species to have evolved isolated Q-detectors or the capacity for representing Q-alone.

Our point at present is not to adjudicate between these different conceptions of intentionality. Rather, each provides a framework within which one may ask different kinds of questions about the behavior of animals. As such, each provides opportunities for research. Dennett's framework emphasizes orders of intentionality as a significant evolutionary variable, and Dennett (1983) suggests experiments that one might perform with vervet monkeys (*Cercopithecus aethiops*) to test his ideas. Dennett is also concerned to explain how animals may sometimes show evidence of higher-order capabilities while at other times or in other contexts showing a lack of ability to reason at a similarly high level—a phenomenon that would be puzzling if the animals were ideally rational. But from within Millikan's perspective this puzzle does not arise. This is because intentional states which are supposed (evolutionarily) to correspond to the intentional states of other organisms (second-order content) need not be related by inference to any general ability to form states with second-order intentional content. An animal may have very specific cognitive abilities with respect to particular intentional states of other organisms, without having the general ability to attribute intentional states to those organisms.

Returning to Rosenberg's third-order account of pretense we see that whether or not one regards it as plausibly attributed to nonhuman animals depends on the general account of intentionality that is adopted. From the intentional stance, if *a* believes that *b* believes that *a* desires to play (third-order) it would seem that ideal rationality would also require that *a* believes that *b* has a belief (second-order). But from a Millikanian perspective this more general second-order belief, if it requires *a* to have a general belief detector, may actually be more sophisticated than the third-order belief which supposedly entails it. A general belief detector may be much more difficult to evolve than a specific belief detector, for the detection of specific beliefs may be accomplished by the detection of correspondingly specific cues.

If this is correct, then on Millikan's account Jethro (Marc's dog) may be capable of the third-order belief that (or, at least, a state with the intentional content that) Sukie (Jethro's favorite canid play pal) wants Jethro to believe that her bite was playful and not aggressive, even though Jethro is perhaps limited in his ability to represent and hence think about Sukie's second-order desires in general. Further below we shall argue for such an understanding of the content of play signals using Millikan's approach to intentionality.

If one takes a Dennettian approach to third-order intentionality, then Rosenberg's third-order analysis of pretense seems over-inflated. It is doubtful that many animals could make the general inferences that the rationality assumption seems to require them to be capable of making from any specific third-order belief. A particular behavioral sequence in social play may involve pretense even though neither participant has a general conception of pretense. In social play, an animal, *a*, may, for example, bare her teeth in a gesture that might also occur during or as a prelude to a fight. The playmate, may respond by growling—another behavior that could occur during a fight. The first animal, *a*, may then pounce on *b* and grasp some portion of *b*'s body between her teeth. This sequence involves motor patterns found in fighting, yet the animals are not fighting. What cognitive abilities must *a* and *b* possess for this to be possible? They must be capable of discriminating those occasions when a behavior is genuinely aggressive from those when it is playful. This could be achieved by detecting subtle differences between, for example, aggressive teeth baring and playful teeth baring—if such differences exist. In the only study of its type of which we are aware, Hill & Bekoff (1977) found that bites directed towards the tail, flank, legs, abdomen, or back lasted a significantly shorter time and were more stereotyped during social play than during aggression in Eastern coyotes. Or it can be achieved by providing contextual cues that inform players about the difference between aggression and play. As we shall discuss below, in many species signals have evolved to support the second approach, and such signals may be understood as intentional icons that convey the messages about the intentions of the play participants.

Play Signals

When animals play they typically use action patterns that are also used in other contexts, such as predatory behavior, antipredatory behavior, and mating. These action patterns may not be intrinsically different across different contexts, or they may be hard to discriminate even for the participants. To solve the problems that might be caused by, for example, confusing play for mating or fighting, many species have evolved signals that function to establish and maintain a play 'mood' or context. In most species in which play has been described, play-soliciting signals appear to foster some sort of cooperation between players so that each responds to the other in a way consistent with play and different from the responses the same actions would elicit in other contexts (Bekoff 1975, 1978, 1995b; Bekoff & Byers 1981; Fagen 1981; Bekoff & Allen 1992). Play-soliciting signals also provide aid to the interpretation of other signals by the receiver (Hailman 1977, p. 266). Coyotes, for example, respond differently to threat gestures in the absence of any preceding play signal than they do to threat gestures that are immediately preceded by a play signal or in the middle of sequence that was preceded by a play signal (Bekoff 1975). Given the possible risks that are attendant on mistaking play for another form of activity, it is hardly surprising that animals should have evolved clear and unambiguous signals to solicit and maintain play.

The canid 'play bow', a highly ritualized and stereotyped movement that seems to function to stimulate recipients to engage (or to continue to engage) in social play (Bekoff 1977), provides an excellent example of what we are calling a play signal and it has been extensively studied in this context. That play bows are important for initiating play is illustrated by the example of a dominant female coyote pup who was successful in initiating chase play with her subordinate brother on only 1 of 40 (2.5%) occasions. Her lone success occurred on the only occasion in which she had signaled previously with a bow, although on the other occasions she engaged in a variety of behaviors that are sometimes successful in initiating play such as rapid approach/withdrawals, exaggerated pawing toward the sibling's face, and head waving and low grunting (Bekoff, 1975).

To say that the bow is stereotyped is to say that the form that play bows take is highly uniform without implying anything about the contextual versatility with which bows are used. When performing a bow, an individual crouches on its forelimbs, remains standing on its hindlegs, and may wag its tail and bark. The bow is a stable posture from which the animal can move easily in many directions, allowing the individual to stretch its muscles before and while engaging in play, and places the head of the bower below another animal in a non-threatening position. Play-soliciting signals show little (but some) variability in form or temporal characteristics (Bekoff 1977). The first play bows that very young canids have been observed to perform are highly stereotyped, and learning seems to be relatively unimportant in their development. The stereotyped nature of the play bow is probably important for avoiding ambiguity.

Play bows occur throughout play sequences, but most commonly at the beginning or towards the middle of playful encounters. In a detailed analysis of the form and duration of play bows (Bekoff 1977) it was shown that duration was more variable than form, and that play bows were always less variable when performed at the beginning, rather than in the middle of, ongoing play sequences. Three possible explanations for this change in variability include (1) fatigue, (2) the fact that animals are performing them from a wide variety of preceding postures, and (3) there is less of a need to communicate that this is still play than there is when trying to initiate a new interaction. These explanations are not exclusive alternatives.

The Meaning of Play Bows

Play bows occur almost exclusively in the context of play, and it is common to gloss play-soliciting signals with the message ‘what follows is play’ or ‘this is still play’. What is the significance of these glosses for the players themselves? Are they in any way aware of the meaning of the play bows, or are they simply conditioned to respond differently, e.g. less aggressively or less sexually, when a specific action such as a bite or a mount is preceded by a play bow?

One way to approach this question is to ask whether play signals such as bows are used to maintain social play in situations where the performance of a specific behavior during a play bout could be misinterpreted. A recent study of the structure of play sequences (Bekoff 1995b) showed that bows in some canids, infant and adult domestic dogs, infant coyotes, and infant wolves, are often used immediately before and after an action that can be misinterpreted and disrupt ongoing social play. Recall that the social play of canids (and of other mammals) contains actions, primarily bites, that are used in other contexts that do not contain bows (e.g. agonistic, predatory, or antipredatory). Actions such as biting accompanied by rapid side-to-side shaking of the head are used in aggressive interactions and also during predation and could be misinterpreted when used in play.

Bekoff asked the following questions: (1) What proportion of bites directed to the head, neck, or body of a play partner and accompanied by rapid side-to-side shaking of the head are immediately preceded or followed by a bow? (2) What proportion of behavior patterns other than bites accompanied by rapid side-to-side shaking of the head are immediately preceded or followed by a bow? Actions considered here were mouthing or gentle biting during which the mouth is not closed tightly and rapid side-to-side shaking of the head is not performed, biting without rapid side-to-side shaking of the head, chin-resting, mounting from behind (as in sexual encounters), hip-slamming, standing-over assertively, incomplete standing-over, and vocalizing aggressively (for descriptions see Bekoff 1974; Hill & Bekoff 1977). Not considered was the situation in which the recipient of bites accompanied by rapid side-to-side shaking of the head performed a bow immediately before or immediately after its partner performed bites accompanied by rapid side-to-side shaking of the head or other actions, because these rarely occurred. It was hypothesized that if bites accompanied by rapid side-to-side shaking of the head or other behavior patterns could be or were misread by the recipient, resulting in a fight, for example, then the animal who performed such actions might have to communicate that they were performed in the context of play and were not meant to be taken as an aggressive or predatory move. On this view, bows would not occur randomly in play sequences; the play atmosphere would be reinforced and maintained by performing bows immediately before or after actions that could be misinterpreted.

The results of Bekoff's study support the inference that bows might serve to provide information about other actions that follow or precede them. In addition to sending the message 'I want to play' when they are performed at the beginning of play, bows performed in a different context, namely during social play, might also carry the message 'I want to play despite what I am going to do or just did—I still want to play' when there might be a problem in the sharing of this information between the interacting animals. Species differences were also found that can be interpreted by what is known about variations in the early social development of these canids (Bekoff 1974; see also Feddersen-Petersen 1991). The interspecific differences also are related to the question at hand. For example, infant coyotes are much more aggressive and engage in significantly more rank-related dominance fights than either the infant (or adult) dogs or the infant wolves who were studied. During the course of this study, no consistent dominance relations were established in either the dogs or the wolves, and there were no large individual differences among the play patterns that were analyzed in this study. Social play in coyotes typically is observed only after dominance relationships have been established in paired interactions. Coyotes appear to need to make a greater attempt to maintain a play atmosphere, and indeed, they seem also to need to communicate their intentions to play *before* play begins more clearly than do either dogs or wolves who have been studied (Bekoff 1975, 1977). Subordinate coyote infants are more solicitous and perform more play signals later in play bouts. These data suggest that bows are not non-randomly repeated merely when individuals want to increase their range of movement or stretch their muscles. However, because, among other things, the head of the bowing individual is usually below that of the recipient, bowing may place the individual in a non-threatening, self-handicapping, posture. Self-handicapping might occur when the bowing animal is dominant or subordinate to her partner: when the bower is dominant she may be sending the message 'I do not want to dominate you more' and when the bower is subordinate she may be sending the message 'I am not trying to dominate you.'

Standing-over, which usually is an assertion of dominance in infant coyotes (Bekoff, 1974) but not in infant beagles or wolves of the same age was followed by a significantly higher proportion of bows in coyotes when compared to dogs or to infant wolves. Because bows embedded within play sequences were followed significantly more by playing than by fighting after actions that could be misinterpreted were performed (unpublished data), it does not seem likely that bows allow coyotes (or other canids) more readily to engage in combat, rather than play, by increasing their range of movement, although this possibility can not presently be ruled out in specific instances.

In addition to the use of signals such as bows, it is also possible that the greater variability of play sequences when compared to sequences of agonistic behavior (Bekoff & Byers 1981) allows animals to use the more varied sequences of play as a composite play signal that helps to maintain the play mood; not only do bows have signal value but so also do play sequences (Bekoff 1976; 1977). Self-handicapping occurring, for example, when a dominant individual allows itself to be dominated by a subordinate animal, also might be important in maintaining on-going social play (Altmann 1962). Watson & Croft (1996) found that red-neck wallabies (*Macropus rufogriseus banksianus*) adjusted their play to the age of their partner. When a partner was younger, the older animal adopted a defensive, flat-footed posture, and pawing rather than sparring occurred. In addition, the older player was more tolerant of its partner's tactics and took the initiative in prolonging interactions. While more data are needed, this study also suggests that the benefits of play may vary according to the age of the player.

Putting Play in a Broader Cognitive Context

The data presented above suggest that at least some canids (and most likely other mammals) cooperate when they engage in social play, and may negotiate these cooperative ventures by sharing their intentions. Fagen (1993, p. 192) has also noted that 'Levels of cooperation in play of juvenile primates may exceed those predicted by simple evolutionary arguments…' In general, animals engaged in social play use specific signals to modulate the effects of behavior patterns that are typically performed in other contexts, but whose meaning is changed in the context of play. These signals are often flexibly related to the occurrence of events in a play sequence that might violate expectations within that sequence. Furthermore, the relationship of play to a cognitive appreciation of the distinction between reality and pretense provides an important link to other cognitive abilities, such as the ability to detect deception or to detect sensory error. Given these connections, a detailed consideration of some selected aspects of social play might help promote the development of more sophisticated theories of consciousness, intentionality, representation, and communication.

The ability to engage in pretend play (e.g., to manipulate an object as if it is something else) normally first appears in human children around 12 months of age (Flavell et al. 1987). This is well before children appear to be capable of attributing mental states to others. Human children also seem capable of engaging in social play before they have a developed theory of mind. Leslie, in the quotation given earlier, expresses surprise about the distortion of reality implied by pretense. We, however, are inclined to suggest that play is one way that an animal may learn to discriminate between its perceptions of a given situation and reality, learning, for example to differentiate a true threat from a pretend threat. From this perspective it would be perhaps more surprising if cognitively sophisticated creatures could get to this point without the experiences afforded by play (for related discussion see Parker & Milbraith 1994).

It is also possible that experiences with play promote learning about the intentions of others. Even if the general capacity for understanding the mental states of others is a specifically human trait, many other species may be able to share information about particular intentions, desires, and beliefs. How might a play bow serve to provide information to its recipient about the sender's intentional state? It is possible that the recipient shares the intentions (beliefs, desires) of the sender based on the recipient's own prior experiences of situations in which she performed bows. Given our earlier discussion of specialized mechanisms, it may be reasonable to attribute a very specific second-order inference of the form 'when I bow I want to play so when you bow you want also to play' without being committed to a general capacity for the possession of second-order mental states in these animals.

Recently, Gopnik (1993, p. 275) has argued that '…certain kinds of information that comes, literally, from inside ourselves is coded in the same way as information that comes observing the behavior of others. There is a fundamental cross-modal representational system that connects self and other.' Gopnik (see also Meltzoff & Gopnik 1993) claims that others' body movements are mapped onto one's own kinesthetic sensations, based on prior experience of the observer, and she supports her claims with discussions of imitation in human newborns.

For example, Gopnik wants to know if there is an equivalence between the acts that infants see others do and the acts they perform themselves, and imagines 'that there is a very primitive and foundational "body scheme" that allows the infant to unify the seen acts of others and their own felt acts into one framework' (Gopnik 1993, p. 276). If by 'primitive and foundational' Gopnik means phylogenetically old, then there should be some examples, or at least precursors, of this ability in other animals. Gopnik and her colleague Andrew Meltzoff also consider the possibility that there is 'an innate mapping from certain kinds of perceptions of our own internal states … In particular, we innately map the body movements of others onto our own kinesthetic sensations. This initial bridge between the inside and the outside, the self and other, underlies our later conviction that all mental states are things both we and others share' (Gopnik 1993, p. 275; see also Flanagan 1992, pp. 102ff).

How these ideas might apply to nonhuman animals awaits further study. There are preliminary suggestions that Gopnik's ideas might enjoy some support from comparative research on animal cognition. For example, Savage-Rumbaugh (1990, p. 59) noted that 'Likewise, if Sherman screams when he is upset or hurt, Sherman may deduce that Austin is experiencing similar feelings when he hears Austin screams. This view is supported by the observation that Sherman, upon hearing Austin scream, does not just react, but searches for the cause of Austin's distress.' This cause-effect relationship is generated after sufficient experience—if an animal screams when he is upset or hurt he may deduce that another is experiencing similar feelings when he hears a scream. Tomasello et al. (1989) also note that some gestures in chimpanzees may be learned by 'second-person imitation'—'an individual copying a behavior directed to it by another individual' (p. 35). They conclude (p. 45) that chimpanzees '…rely on the sophisticated powers of social cognition they employ in determining what is perceived by a con-specific and how that conspecific is likely to react to various types of information…'

There is also the possibility that in social play one dog might be able to know that another dog wants to play by knowing what she feels like when she performs a play bow. Among the questions that need to be studied in detail is, 'Does a dog have to have performed a bow (or other action) before knowing what a bow means and subsequently being able to make attributions of mental states to other individuals?' The following two hypotheses would have to be distinguished: (1) viewing a play bow induces a play mood in the recipient because of kinesthetic mapping and (2) viewing a play bow induces knowledge in the recipient of how the actor feels. With respect to bows, at least, there are data that suggest that there is a genetic component to them; the first bows that are observed to be performed by young canids are highly stereotyped and occur in the correct social context (Bekoff 1977). Could these data support Gopnik's idea about the 'primitive and foundational "body scheme"? And, if so, how is learning incorporated into the development of social communication skills? Regardless of how nature and nurture mix, sparse evidence at hand supports the view that studies of animal cognition can inform the study of human cognition, and that much more comparative research is needed.

Concluding Remarks: Social Play and Comparative Studies of Animal Cognition

Because social play is a widespread phenomenon, especially among mammals, it offers the opportunity for much more truly comparative and evolutionary work on intentionality, communication, and information sharing (see also Parker & Milbraith 1994). The collection of new data will provide for a much broader perspective on the origins of intentionality in diverse species. Nonetheless, some primatologists write as if theirs are the only subjects who are capable of recognizing the intentions of others. For example, Byrne (1995, p. 146) writes: '…great apes are certainly "special" in some way to do with mentally representing the minds of others. It seems that the great apes, especially the common chimpanzee, can attribute mental states to other individuals; but no other group of animals can do so—apart from ourselves, and perhaps cetaceans.' To dismiss the possibility that nonprimates are capable of having a theory of mind, not only do more data need to be collected, but existing data about intentionality in nonprimates need to be reconsidered (see also Beck 1982 on chimpocentrism). Furthermore, claims about the uniqueness of nonhuman primates are often based on very few comparative data derived from tests on small numbers of nonhuman primates who might not be entirely representative of their species. The range of tests that have been used to obtain evidence of intentional attributions is also extremely small, and such tests are often biased towards activities that may favor apes over monkeys or the members of other species. There is evidence (Whiten & Ham 1992) that mice can outperform apes on some imitation tasks. These data do not make mice 'special'; rather they suggest that it is important to investigate the abilities of various organisms in respect to their normal living conditions. The study of social play affords this opportunity.

Acknowledgments

Some of the material in this chapter has been excerpted from Allen & Bekoff (1997) with permission of The MIT Press. Colin Allen was supported by NSF grant SBR-9320214 during the writing of this chapter. Maxeen Biben provided helpful comments.

References

Allen, C. and M. Bekoff
1994 Intentionality, social play, and definition. *Bio. Phil.*, 9, 63–74.

Allen, C. and M. Bekoff
1997 *Species of Mind: The Philosophy and Biology of Cognitive Ethology.* Cambridge, Massachusetts: MIT Press.

Altmann, S. A.
1962 Social behavior of anthropoid primates: Analysis of recent concepts. In: E. L. Bliss (eds.), *Roots of Behavior*, pp. 277–85. New York: Harper.

Beck, B. B.
1982 Chimpocentrism: bias in cognitive ethology. *J. Human Evol.*, 11, 3–17.

Bekoff, M.
1974 Social play and play-soliciting by infant canids. *Amer. Zool.*, 14, 323–40.

Bekoff, M.
1975 The communication of play intention: Are play signals functional? *Semiotica*, 15, 231–9.

Bekoff, M.
1976 Animal play, problems and perspectives. *Persp. Ethol.*, 2, 165–88.

Bekoff, M.
1977 Social communication in canids, Evidence for the evolution of a stereotyped mammalian display. *Science*, 197, 1097–9.

Bekoff, M.
1978 Social play, Structure, function, and the evolution of a cooperative social behavior. In: G Burghardt & M. Bekoff (eds.), *The Development of Behavior: Comparative and Evolutionary Aspects*, pp. 367–83. New York: Garland.

Bekoff, M.
1995a Cognitive ethology and the explanation of nonhuman animal behavior. In: H. L. Roitblat and J.-A. Meyer (eds.), *Comparative Approaches to Cognitive Science*, pp. 119–50. Cambridge: Massachusetts: MIT Press.

Bekoff, M.
1995b Play signals as punctuation, The structure of social play in canids. *Behaviour*, 132, 419–29.

Bekoff, M.
1998 Playing with play, What can we learn about evolution and cognition? In: D. Cummins & C. Allen (eds.), *The Evolution of Mind*, New York: Oxford University Press.

Bekoff, M. and C. Allen
1992 Intentional icons: towards an evolutionary cognitive ethology. *Ethology*, 91, 1–16.

Bekoff, M. and J. A. Byers
1981 A critical reanalysis of the ontogeny of mammalian social and locomotor play, An ethological hornet's nest. In: K. Immelmann, G. W. Barlow, L. Petrinovich, and M. Main (eds.), *Behavioral Development, The Bielefeld Interdisciplinary Project*, pp. 296–337. New York: Cambridge University Press.

Bekoff, M. and D. Jamieson (ed.)
1996 *Readings in Animal Cognition.* Cambridge, Massachusetts: MIT Press.

Burghardt, G. M.
1998 Play. In: G. Greenberg and M. Haraway (eds.), *Encyclopedia of Comparative Psychology*, New York: Garland.

Byers, J. A. and C. Walker
1995 Refining the motor training hypothesis for the evolution of play. *Amer. Nat.*, 146, 25–40.

Byrne, R.
1995 *The Thinking Ape: Evolutionary Origins of Intelligence.* New York: Oxford University Press.

Darwin, C.
1871/1936 *The Descent of Man and Selection in Relation to Sex.* New York: Random House; Modern Library edition.

Dennett. D. C.
1969 *Content and Consciousness.* New York: Routledge and Kegan Paul.

Dennett, D. C.
1983 Intentional systems in cognitive ethology, The 'Panglossian paradigm' defended. *Behav. Brain Sci.*, 6, 343–90.

Dennett, D. C.
1987 *The Intentional Stance.* Cambridge, Massachusetts: MIT Press.

Fagen, R. M.
1981 *Animal Play Behavior.* New York: Oxford University Press.

Fagen, R.
1993 Primate juveniles and primate play. In: M. E. Pereira and L. A. Fairbanks (eds.), *Juvenile Primates: Life History, Development, and Behavior*, pp. 183–96. New York: Oxford University Press.

Feddersen-Petersen, D.
1991 The ontogeny of social play and agonistic behaviour in selected canid species. *Bonn. Zool. Beitr.*, 42, 97–114.

Flanagan, O. J.
1992 *Consciousness Reconsidered.* Cambridge, Massachusetts: MIT Press.

Flavell, J., E. Flavell, and F. Green

1987 Young children's knowledge about the apparent-real and pretend-real distinctions. *Dev. Psych.*, 23, 816–22.

Gopnik, A.

1993 Psychopsychology. *Consciousness and Cognition*, 2, 264–80.

Grice, H. P.

1957 Meaning. *Phil. Rev.*, 66, 377–88.

Hailman, J. P.

1977 *Optical Signals: Animal Communication and Light.* Bloomington, Indiana: Indiana University Press.

Hill, H. L. and M. Bekoff

1977 The variability of some motor components of social play and agonistic behaviour in infant eastern coyotes *Canis latrans var. Anim. Behav.*, 25, 907–9.

Huber, P.

1810 *Recherche sur les moeurs des fourmis indigènes.* Paris, Geneve: J. J. Paschoud.

Jamieson, D. and M. Bekoff

1993 On aims and methods of cognitive ethology. *Phil. Set. Assoc.*, 2, 110–24.

Leslie, A. M.

1987 Pretense and representation. The origins of 'theory of mind.' *Psych. Rev.*, 94, 412–26.

Martin, P. and T. M. Caro

1985 On the functions of play and its role in behavioral development. *Adv. in the Study of Behavior*, 15, 59–103.

Meltzoff, A., and A. Gopnik

1993 The role of imitation in understanding persons and developing a theory of mind. In: S. Baron-Cohen, H. Tager-Flusberg, and D. Cohen (eds.), *Understanding Other Minds*, pp. 335–66. New York: Oxford University Press.

Millikan, R. G.

1984 *Language, Thought, and Other Biological Categories.* Cambridge, Massachusetts: MIT Press.

Parker, S. T. and C. Milbraith

1994 Contributions of imitation and role-playing games to the construction of self in primates. In: S. T. Parker, R. W. Mitchell, and M. L. Boccia (eds.), *Self-Awareness in Animals and Humans: Developmental Perspectives*, pp. 108–128. New York: Cambridge University Press.

Povinelli, D. J. and J. G. H. Cant

1995 Arboreal clambering and the evolution of self-conception. *Q. Rev. Bio.*, 70, 393–421.

Rosenberg, A.
1990 Is there an evolutionary biology of play? In: M. Bekoff & D. Jamieson (eds.), *Interpretation and Explanation in the Study of Animal Behavior, Vol. I, Interpretation, Intentionality, and Communication*, pp. 180–96. Boulder, Colorado: Westview Press. (Reprinted in Bekoff & Jamieson 1996.)

Savage-Rumbaugh, E. S.
1990 Language as a cause-effect communication system. *Phil. Psych.*, 3, 55–76.

Schaller, G. B. and G. R. Lowther
1969 The relevance of social carnivore behavior to the study of early hominids. *Southwest J. Anthro.*, 25, 307–41.

Stich, S.
1983 *From Folk Psychology to Cognitive Science.* Cambridge, Massachusetts: MIT Press.

Tinbergen. N.
1972 Foreword to Hans Kruuk. *The Spotted Hyena.* Chicago: University of Chicago Press.

Tomasello, M., D. Gust, and G. T. Frost
1989 A longitudinal investigation of gestural communication in young chimpanzees. *Primates*, 30, 35–50.

Watson, D. M. and D. B. Croft
1996 Age-related differences in playfighting strategies of captive male red-necked wallabies (*Macropus rufogriseus banksianus*). *Ethology*, 102, 336–46.

Whiten, A. and R. Ham
1992 On the nature and evolution of imitation in the animal kingdom: Reappraisal of a century of research. *Adv. Study Behav.*, 21, 239–83.

Prefigurements of Art*

Thomas A. Sebeok

> “In our own day the philosopher neither minimises nor unduly magnifies the mechanical aspect of the Cosmos; nor need the naturalist either exaggerate or belittle the mechanical phenomena which are profoundly associated with Life, and inseparable from our understanding of Growth and Form” (Thompson 1945: 7).
>
> “To the biologist … and to the painter, improvement is a perfectly valid notion, proof against any attacks philosophers may make on it. … And the point I want to make is that in the biological process of evolution, chance processes are among the essentials on which improvement depends. They are not the only essential. The other main one is the occurrence of selection; some of the novelties produced by chance are preserved, others are rejected and allowed to disappear. … And the practice of modern painters shows that they have accepted chance as a potentially valuable component of the creative process” (Waddington 1969: 107–108).

0. Preliminaries

That language is a biotic property specific to man is true—a truism even—in the sense that no other species encountered so far is, in the technical acceptation of this term, language-endowed. Language is a cognitive structure which, like the behavioral extension of any organ of man’s body, may be studied along several more or less agreed upon semiosic/ethological dimensions (Sebeok 1979, Ch. 2) including the characters of its initial state (ontogenesis), mature state, and end-state (gradual breakdown, partial reconstitution, and eventual termination) (*ibid.*, Ch. 4). With regard to the phylogenesis of language, there has been much random conjecture and some empirical stumbling, but scarcely even translucent enlightenment so far. Verbal sign configurations have been elaborated throughout history into many complex forms of message oriented constructs, encompassing both spoken and literary genres, which, are best called jointly—as I had

---

* Sebeok, Thomas A. 1979. Prefigurements of art. *Semiotica* 27(1-3): 3–74. Original figures are not reproduced.

suggested nearly a quarter of a century ago (Bascom 1955: 246, fn. 9; Bauman 1977: 4, 49, n. 2)—the ‘verbal art’. Furthermore, language, being “absolutely distinct from any system of communication in other animals”, and thus “also the most diagnostic single trait of man” (Simpson 1966: 476), has as its corollary, by definition as it were, the tautologic proposition that man has a monopoly on all manifestations of the verbal art. These statements and their implication, while hardly contestable, are surely trivial, owing to the equally unchallengeable fact that the communication system of every *other* species stamps it with a unique hallmark, much as language conspicuously segregates out our humanity (Sebeok 1978a). They do, however, suggest one interesting question which I propose to explore, if tentatively, in what follows, namely, whether the optimal design of certain animal communication systems can allow, given certain contextual conditions, for a superimposed aesthetic function. In other words, how reasonable is it to search for prefigurements of aesthetically charged averbal sign configurations in man’s animal ancestry? What, for instance, could Julian Huxley have meant when he asserted in passing, during a Darwin Centennial panel discussion, that in the behavior of the Satinbird (*Ptilonorhynchus violaceus*)—a remarkable bowerbird living in the coastal forests of Eastern Australia, and a species certain members of which paint the inside of their bower efficiently, even, to echo Huxley’s word, “deliberately”—there is “definitely the beginning of aesthetics” (Tax and Callender 1960: 195)? A pioneer ornithologist, Stonor (1940: 96–97), had commented on this painting behavior in a similar vein: “Exactly what the motive is behind this painting is obscure; presumably it is an expression of the bird’s love of decoration. It has been suggested that it is connected with its liking for dark colours…” This seemingly bizarre habit, Marshall (1954: 65) later likewise surmised, “may be an aesthetic extension of a basic drive”, namely, the birds’ courtship feeding phenomenon—or just the sort of displacement activity of sexual behavior that some Freudians have posited in men. Gannon (1930: 39), the discoverer of bower painting in this species, also observed that the male appeared to employ a tool—a wad of bark, like a brush or sponge, held in the tip of the bill—to apply the paint, which is composed of saliva mixed by the bird with charcoal dust, dark berries, or woodpulp. It was subsequently noted that the paint, washed away by the heavy tropical rains, is replaced daily during the height of the sexual season and fibrous bark, often still saturated with charcoal and saliva, is commonly to be found on the avenue floor between the two painted walls and where fallen leaves are always quickly removed. This bird, when constructing its social signals, exhibits a decided preference for blue, less so for yellowish-green, shunning red altogether, a bias manifested, moreover, in such like-colored ornamental objects as feathers, flowers, leaves, berries, snail shells, cicada integument, and, near human habitations, pieces of blue-colored glass beads, strands of wool and tinsel (Frisch 1974: 238–39). Generalizing about the entire family *Ptilorhynchidae*, of which about nineteen species occur, Dobzhansky (1962: 215) remarks that "it is impossible to deny that a well-adorned bower may give the bird a pleasure which can only be called aesthetic". Recall in this context Nicolas Poussin's maxim—a 17th century evocation of the mediaeval doctrine of *delectatio* as a sign—that "la fin de l'art est la délectation", apropos of which Panofsky (1955: 10–11) insists that "a work of art always *has* aesthetic significance", regardless of whether it serves some practical—let me qualify: biological—purpose at bottom. We must likewise concede the possibility that "animals perform some of the behavior patterns we observe because they enjoy the resulting experience" (Griffin 1976: 78), regardless of whether such patterns are adaptive, or virtually so, "but result in a pleasantly satisfying feeling" on the animals' part. Whether or not bowers are built, painted, and decorated for the maker's pleasure, the fact remains that the constructions take place, as a rule, during the breeding season and serve as the sites where territorial displays are performed. The key issue, what the differential effect of the bowers may be on the females, remains unresolved, because this has not been systematically tested.[1]

---

1. Even these remarks may need to be modified in the light of such casual but expert observations as Ripley's (in Eisenberg and Dillon 1971: 8–9), concerning a species of gardener bowerbird (*Amblyornis*) in New Guinea. Ripley reports how he pondered in awe the proportionately huge, six-foot, tepee-like structure made by one of these birds; he describes how he would be drawn back, day after day, to one or another of the bowers near his camp, to watch the placing of particular fruits, berries, or flowers in neat, foot-square beds. He then continues: "…I found that these bowers are virtually a year-round preoccupation with the male birds rather than an extra-long seasonal one, and that the female may come and visit the bower during the nonbreeding season as well. Furthermore, the young males watch the adult birds and so, during the several years of their maturation period, may have a chance to profit by the example of their elders. By this process of transfer of training as well as an enhancement of innate instincts is taking place. I say this because I was able to observe critical selections for color and tone of objects. In one case a flower that I had picked, which was not being used to make up one of the flower beds, was rejected out of hand by the male bird presumably for reasons of color. In another case a flower, not otherwise picked by a male bird, was accepted and, after being slightly rearranged, was included in the bed, even though the flower was of a different species. The color, a pinkish red of this orchid, matched very well the pinkish red of the bed flowers from a vine". Ripely then goes on to narrate how he was able to create a new vogue among two of the bowerbirds. These observations, as raw data, are highly suggestive and of heuristic value, if not, of course, conclusive.

Contrary to Barthes' (1957: 222) contention, that the semiotician is entitled to treat writing and pictures in the same way because what he retains from them both is "qu'elles sont toutes deux des *signes*", in all living systems that I know of the characteristics of the signs employed are inseparably joined to the kind of information they carry. Similarly, the concept of "secondary modeling system" (Lotman 1967: 130–31), which is assuredly among the more salient features of Soviet semiotics, posits a superstructure that persistently confounds two diverse artistic realizations which, I would argue, demand radically different treatment: on the one side, the products of the verbal art and its derivatives, being inescapably built up from signs that are the operands of a natural language, plus certain traditional or newly invented rules for combining them in possible, impossible, contingent, or imperative ways to advance human cognition and communication; and, on the other side, the artistic products of averbal semiotic systems into which verbal signs may, to be sure, encroach in varying degree. The performances we call the verbal art and those that we call the averbal arts generate, respectively, in the dominant and the minor hemisphere, although the specializations normally have a complementary relationship. As Eccles (Popper and Eccles 1977: 351–52) has recently pointed out, "the minor hemisphere is specialized in relationship to pictures and patterns, and it is musical". This separation of hemispheric functions, by the evidence to date, is genetically coded. The minor hemisphere is best envisaged as "a very superior animal brain" (Sebeok 1977: 1070), a conception which points precisely in the direction in which future researches are most likely to prove fruitful. The two repertoires of signs may, and often doubtless do, "enter into subtle semantic relationships", as Veltruský emphasizes (Matejka and Titunik 1976: 254), the resulting meaning being compounded by a process called codified contiguity. This is achieved by the immense and incessant traffic in the corpus callosum linking the two cerebral hemispheres of the intact human brain, for "probably everything that happens in the minor hemisphere leads to a kind of reverberation in the major hemisphere" (Popper, in Popper and Eccles 1977: 482). There is, however, no ground that I know of for belief that would compel the conclusion that the interpretant of *every* artistic sign must have a verbal component; and should a semiotic system of the second kind be identified in the infrahuman biosphere, it would certainly be altogether delusive to postulate a verbal infrastructure for the sort of hemispheric specialization intimated is, after all, "unique to man" (*ibid.* 353).

The authentic singularity of man consists of this, that he alone disposes over a *pair* of communicative codes: "along with our wholly new and wholly distinct system of true language" (Simpson, *ibid.*), the verbal code, we retain an older system that, for want of a better name (Sebeok 1976: 156–62, 1977: 1063–

67), is frequently, contrastively, and hence negatively designated as a human manifestation of a cross-specific averbal code. The latter comprehends a trio of subcodes recently differentiated into separate categories by Uexküll (forthcoming): first, endosemiotic averbal sign systems, or the metabolic code (Sebeok 1979, Ch. 1), involving humoral and nervous factors that convey information within the bodies of all animals, including man (cf. Autrum 1972); second, somatosemiotic averbal sign systems, that function to compact the unity of every organism (cf. *ibid.*, Appendix I), a notion kindred to Leibniz's concept of apperception (as expressed in his c. 1714 paper, *Principes de la nature et de la grâce, fondés en raison*), which is our conscious reflection of the inner state of the monad; and third, outspreading averbal sign systems, such as are used for communication between organisms and between any organism and its external environment. In man, the output of this entire array of subcodes, but particularly of the third kind, is exquisitely harmonized in performing with his outpouring of verbal messages, although the diverse repertories each serve separate ends substantially at variance one from the other—a point worth reemphasizing with Bateson (1968: 615), who rather clearly saw how wrong it is to assume that, in hominid evolution, verbal semiosis has, in any sense, replaced "the cruder systems of the other animals" (*ibid.* 614), that is, averbal semiosis. Had this been the case, our averbal skills and the organs that execute them would inevitably have undergone conspicuous decay. Obviously, they have not; on the contrary, while the verbal art flourished, we have perfected our averbal arts as well—they too "have been elaborated into complex forms of art, music, ballet … and the like, and, even in everyday life, the intricacies of human kinesic communication, facial expression and vocal intonation far exceed anything that any other animal is known to produce" (*ibid.*).

The ideal of semiosic analysis is to combine causal with functional explanation—to show how sign form interrelates dynamically with sign function, both in synchrony and in diachrony. But an evolutionary sequence is hard to come by in an area so complex and multiply amphibological as art. Instances may be temporally ordered but are not necessarily in linked sequence. Guthrie (1976, Ch. 9) offers some interesting ideas, in a semiotic frame, "about how some aspects of our aesthetic sense evolved" (*ibid.* 73), but the part he was concerned with was that which underlies our appreciation of human physical beauty, the valuation of which he traced to two major elements, copulatory lures and status badges. One perhaps insuperable difficulty all investigators have to face is to identify ineffable "signs of artistic enjoyment" in other species (*ibid.*), all of them being creatures that are speechless.

The only general survey I can find in the entire literature of the life sciences of basic aesthetic principles possibly shared by man with at least the higher animals was drafted in the late 1960s by another ethologist, Rensch, in an essay that was published only much later in the U.S. (1974) and Great Britain (1976). This authoritative but still, unfortunately, all too inconclusive review, based in large part on the author's well-known experiments aimed to demonstrate the reality of protoaesthetic phenomena, the results of which were found to be in good conformity with those of psychologists (cf. Arnheim 1954) who studied the elements of aesthetic preferences in human subjects, is devoted in the main to scribblings and paintings by monkeys and apes, with but a laconic page (*ibid.* 345) on "auditive aesthetic sensations". In 1958, Rensch had investigated the efficacy of aesthetic factors in vertebrates, testing preferences for different patterns in a jackdaw, a carrion crow, and six fishes. He showed that, while the fishes always preferred irregular patterns, both species of birds preferred the more regular, more symmetrical, and more rhythmical patterns, doing so in statistically significant numbers. In a color choice test, these birds exhibited a preference for gray and black, being the colors of their own plumage. However, "they preferred patterns with two or four different colours to simpler patterns of one colour or two colours respectively" (Rensch 1958: 461). A student of his, Tigges (1963), later found that jackdaws preferred pure colors (red, blue, yellow, green) to equally bright mixed ones (orange, brown, violet, lilac).

Although painting experiments were conducted by N. N. Ladygin Kohts with a chimpanzee named Joni, in Moscow, as far back as 1913, and Shepherd (1915) reported that a chimpanzee drew lines with a pencil, and many an anecdotal story found its way into the literature since then, there are only three serious studies of primate aesthetics: the series of papers by Rensch (see especially 1961, on drawings and paintings as perhaps prestages of copying), a posthumous publication by Schiller (1951), and the engaging book by Morris (1962), especially showing, on the basis of a detailed analysis of one young chimpanzee, Congo, that the splashes of paint or the pencil marks made by apes are not at all random. The immature Congo, given an incomplete pattern, often made marks which tended to complete it. Alpha, the first-born chimpanzee of the Yerkes Colony, if given a piece of paper, with a cross placed on three of the corners, would put a cross in the fourth corner: "she would also in her crude way try to complete designs and pictures which had been given to her deliberately unfinished or unbalanced" (Bourne 1971: 216). One is thus forced to assume the presence, in advance, of a representation in the animal's nervous system that corresponds to the picture displayed.

The most recent survey of ape creativity may be found in the psychologist Andrew Whiten's excellent account (in Brothwell 1976: 18–40). Rensch, who had worked with a capuchin monkey and a green monkey as well as chimpanzees, observing their drawing or painting with pencil, colored chalk, or brush, professes to have been astonished "to find also aesthetic factors having a positive effect with apes, monkeys and [even] crows comparable with the effect in man" (1972: 90). He believes that our feelings of aesthetic pleasure, as we look at different black and white patterns, are, in the main, attributable to three basic conditions: symmetry, rhythmic repetition of similar component parts, and consistency of curvatures. His results demonstrate that, with these animals, as with man, "the greater facility to apprehend a design, the details of which are rhythmically repeated or otherwise more easily apprehended, the 'complexibility' is connected with positive feelings and arouses aesthetic pleasure" (*ibid.* 91). Rensch (1976: 342) tells of incidents where "competent art experts, on being shown monkeys' paintings without being told who had painted them, sometimes enthusiastically praised the dynamism, rhythm, and sense of balance. In so doing they have not made fools of themselves, but simply confirmed what the experimental biologists had already also established. Of course, when the art historians, museum directors, or architects who had thus been led into pronouncing opinions on such paintings were afterwards told who the 'artists' were, they were always rather put out and sometimes even offended at the deception that had been practiced upon them. … In view of this it is hardly surprising that in cases where, at modern art exhibitions, a surreptitiously included monkey's painting has received acclaim from the critics, subsequent disclosure of the deception has produced something of a scandal, as has occurred in Sweden, for example". (I intend to return to pongid painting in more detail in Section 3 of this paper).

Rensch further supposes that the tendency of apes, including orangutans, and capuchin monkeys to put scarves, ribbons, chains, and the like, around their neck, and to romp about with them on, is to be interpreted as enjoyment of dressing up; hence, in his view, aesthetic factors would be involved in this behavior as well. "It is even more likely", he adds (1972: 91), "that birds find aesthetic pleasure in repeating tunes they hear from other birds or from humans, and in 'composing' new melodies from phrases either learned or already known".

Following these brief prefatory observations, I would like to reexamine in some detail the question of the putative aesthetic propensity of animals, with specific (although uneven) attention to four semiotic spheres: (1) kinesthetic signs, (2) musical signs, (3) pictorial signs, and (4) architectural signs. Sketchy as such a review must be, no such comprehensive literature survey has been attempted before, probably for several reasons. One of these may be due to the fact that cultural anthropologists who have sought to inquire into the biological roots of art have typically set out to do so with a preconception common to many members of the profession. Alland (1977, Ch. 2), for one, opens his chapter on "The Evolution of Art" with this uncompromising sentence: "The creation and appreciation of art in its many forms are uniquely human activities", adding, a few pages later (*ibid.* 24): "True [*sic*] artistic behavior is seen in no species other than *Homo sapiens.* Not even a hint of it occurs in the natural behavior of other species". His brief exploration of its origins, sensitive as it is, suggests that this lies in play as a biological property, leading him to a debatable definition of art as "play involving rules" (*ibid.* 30) (for a semiotic interpretation of play in vertebrates, cf. Sebeok 1976: 139). This same notion was earlier advanced by Ellen Eisenberg (cf. Pfeiffer 1969: 434), subsuming art in a more inclusive class of behavior patterns, one which includes all forms of exploration; and, earlier still, by Dobzhansky (1962: 217), who felt that at least some forms of art "are related to play". (The union of the play-impulse with aesthetic feelings and sentiments, as linked with superfluous activities and corresponding pleasures, was first propagated by Spencer [1897: 2: 627, 647] eighty years ago; he argued that the aesthetic sphere in general may be expected to occupy an increasing part in human life owing to greater economization of energy resulting from superiority of organization bringing a growing proportion of the aesthetic activities and gratifications). Dobzhansky, however, perceived even in artistic activity an adaptive value, for he saw in it a wellspring of social cohesion, thus raising once again a utilitarian interpretation of the role of art. This viewpoint is most fruitfully developed by Jenkins (1958: 14 and *passim*), a thoroughgoing evolutionist, for whom art has its "ultimate source in the human effort to adapt to the environment", and who insists, more generally, that any inquiry into the origins of art must move, as he emphatically puts it, "*toward an analysis of the adaptive situation*". Klopfer (1970: 399), who means by aesthetic preferences simply "a liking for objects or activities because they produce or induce particular neural inputs or emotional states, independently of overt reinforcers", answers his own question, whether we can attribute aesthetic impulses to animals other than man, in the affirmative. The inquiry entails the belief that there must be a biological basis to aesthetics, and thus shifts to a search into the basis thereof: "what are the historical or ultimate reasons for the development of an esthetic sense; by what mechanisms is the development of the species-characteristic preferences assumed?" Klopfer (*ibid.* 400), too, comes up against the predicament posed by the traditional view that aesthetic preferences are those for which no immediate functional advantage can be perceived; consequently, he strikes out in a different direction, seeking for guidance from sensory physiology, while also redefining play as a kind of exploratory activity by which the organism 'tests' different proprioceptive patterns for the goodness of fit.

When ethnologists search for the sources of art, they more often than not mean the verbal art; play thus comes to mean wordplay, which Alland (1977: 27), for one, connects with poetry, and which must then be excluded *per def-*

initionem from the rest of the animal kingdom. Archeologists tend especially to dwell on representative art; as Marshack (1972: 275) puts it, "art and symbol are products that visualize and objectify aspects of culture…". Although, on balance, the neuroanatomist Young (1971: 519) is undoubtedly right when he says, in the course of his synthesis tracing the sources of human activity from their biochemical basis to the highest levels of consciousness, that "there is no body of facts that yet enables us to understand the origins of aesthetic creation…", the issue remains a tantalizing one, for, as another distinguished biologist put it, "in some situations it becomes really difficult not to impute to animals some sort of aesthetics" (Dobzhansky 1962: 215). The dialectic seems to have begun between Darwin, whose theory of sexual selection is based on the assumption that female birds, for example, are able to appreciate the beauty of male plumage (cf. Romanes 1892: 380–85), and his contemporary, Wallace, who disputed this view precisely in semiotic terms. Wallace argued that what is involved here is an instinctive interpretation of certain strings of signs emitted by the male. However this may be, it would be unreasonable to expect a perfunctory and iterative scrutiny of the literature of animal behavior to shed much illumination; a deeper search, on the other hand, might at least highlight some fundamental issues—such as the often misunderstood dichotomy of analogy *vs.* homology, and the even less understood distinction between phyletic homologies and homologies of tradition.

1. Kinesthetic Signs

The kinesthetic art—as the multisensory dance when viewed in a semiotic frame is sometimes reductively termed after its most distinctive feature, because in dance (contrasted, particularly, with mime) "movement is often an end in itself (Royce 1977: 197)—is seldom alluded to in the context of animal behavior. Sachs (1937: 10) adduced several striking cases of bird displays he and others in his field, including recently Royce (*ibid.* 3–4), explicitly dubbed "dancing". One of his examples is cited after Maclaren (1926), who witnessed this dance of the stilt birds, or cranes, in Cape York in Northeastern Australia:

> The birds … were long-legged creatures, tall almost as storks, and white and gray of feather; and the dance took place in the center of a broad, dry swamp. … There were some hundreds of them, and their dance was in the manner of a quadrille, but in the matter of rhythm and grace excelling any quadrille that ever was. In groups of a score or more they advanced and retreated, lifting high their long legs and standing on their toes, now and then bowing gracefully to one another, now and then one pair encircling with prancing daintiness a group whose heads

> moved upwards and downwards and sideways in time to the stepping of the pair. At times they formed into one great prancing mass, with their long necks thrust upward; and the wide swaying of their backs was like unto the swaying of the sea. Then, suddenly, as in response to an imperative command, they would sway apart, some of them to rise in low, encircling flight, and some to stand as in little gossiping groups; and presently they would form in pairs or sets of pairs, and the prancing and bowing, and advancing and retreating would begin all over again.

His second example, which comes from British Guiana, cited after Appun (1871: 468–69), is, as Royce (*ibid.* 4) underlines, "even more interesting since it describes what is essentially a performer-spectator situation":

> [A] group of some twenty mountain chickens of a brilliant orange-yellow color, gathered together in a kind of dance characteristic of these beautiful birds. In the center one of the cocks executed the dance-like movements, as he hopped about the open place with wings extended and tail outspread. On the branches of the bushes round about, the others sat and expressed their admiration of the dancer with the strangest sounds. As soon as one cock was exhausted, he joined the spectators, uttering a peculiar cry, and another took his place.

These parallels immediately raise several problems, the most obvious being whether the animal's behavior is "merely" analogous to man's, whether, that is, shifting to a more familiar parlance, the label "dance" is "just" a colorful and suggestive metaphor—as it must surely be in Frisch's designation (1954, 1967) of the kinetic component of the communication system of the honeybee as a "dance"—or whether something deeper is implied, perhaps indeed a remote phyletic homology.[2] Even if only an analogy is meant, this is far from

---

2. I am not, of course, concerned here with spectacles, like circus acts, where animals have purportedly been trained by dint of a trans-species operation to 'dance' in exhibitions. Hanna (1977: 212) observes: "It is true that a human can dance mechanically or perform a dance pattern conceptualized and created by someone else, in the same way that a nonhuman can be trained to perform a dance by a human. We have all seen 'dancing' chimpanzees, horses, dogs, bears, parrots, or elephants". The latter, however, are only skillfully induced semiotic illusions. The animals' biologically appropriate movements are accompanied by the contrived music, not the other way about: "Une bonne musique est surtout importante dans le travail régulier et tout à fait indispensable dans les airs de danse. En dehors des figures régulieres, il importe seulement qu'elle soit précipitée ou lente suivant la vivacité ou la lenteur des mouvements. Les ours, les chevaux, les éléphants, les chiens danseurs par exemple, nécessitent une musique particulièrement bien adaptée, tandis que les singes, les perroquets, etc., etc., ne réclament que des flonflons à peu près quelconques" (Hachet-Souplet 1897: 32–33). The principles of animal humanization in the circus are explained by Bouissac (1976: 116ff.), such as, for instance, causing them to 'dance' in pairs

valueless, since its study would throw light upon “the laws of function that rule the evolution of a behavior pattern” (Eibl-Eibesfeldt 1975: 233). It is, in fact, highly productive to compare biological constructs with cultural ones if only to ascertain whether seemingly similar signifiers trigger comparable interpretants, in the sense that the wing of an insect (developed from an epidermal fold), the wing of a bird (developed from a vertebrate extremity), and a wing of an airplane (manufactured, say, of metal), are all shaped in response to the universal laws of aerodynamics. Armstrong (1963, Ch. 15), who devoted an entire chapter to drawing parallels between the dances of birds and men, feels that he is justified in employing the identical label for both sets of motor signs because of “a natural recognition of the remarkable similarities which actually exist between the dances of birds and men and the identity of the emotional sources from which both take their origin. The resemblances between avian and human dancing”, he claims, “are the outcome of emotional drives which underlie the behaviour of all the higher animals; and the natural corollary is that we can use the terpsichorean activities of men to interpret those of birds, and vice versa. Let us not be scared”, he concludes, “by the bogey of anthropomorphism into the arms of the spectre of Cartesian mechanism. It is not anthropomorphism to believe that man and the higher animals have much in common so far as instinct and emotion are concerned, but an acknowledgment of truth scientifically demonstrated” (*ibid.* 195).

Sachs questions, by distinguishing—to recast in modern ethological terminology what he says—phyletic homologies, or those that are transmitted via

---

(waltz) or alone (ballet): “The most efficient training in this vein evokes a behavior from the animal that, within the constructed situation, subtly creates the impression that the animal has humanlike motivations, emotions, and reasoning”. Iconicization of movements is attained through musical accompaniment, by “reducing them to a rhythm, either to achieve complete harmony, as in the case of liberty horse acts, or to achieve individual regularity, as in ‘haute école’ acts (dancing horses)” (*ibid.* 131). The same was true, *a fortiori*, of flea circuses (Andrews 1977: 100–06), common in my childhood, and a few of which still operate abroad (the famous American one, at Huber’s Museum, in New York’s Times Square area, closed a generation ago). A program note preserved in the British Museum’s Mansell Collection of an exhibition held, in the 1830s, at Regent Street, in London, speaks of “Two Fleas dressed as Ladies, and Two as Gentlemen dancing as Waltzers, Twelve Fleas in the Orchestra playing on different Instruments of proportionable size …” The occasion was, by all appearances, a lavish affair, “A ball with frock-coated gentlemen partnering silk-clad ladies, whilst a twelve-piece orchestra played audible flea-music; the Great Flea Mogul complete with harem, and a 120-gun ship of the line drawn by a single flea” (*ibid.* 103f.).

the genome, from homologies of tradition, that is, those that are passed on via memory, whether animals in fact do dance as man does. The traditional distinction between innate *vs.* acquired characteristics is not at all as clearcut as Sachs implies, however, and becomes increasingly inappropriate when one considers the alloprimates. One reason for this is that, for research dealing with homologies, "it is only necessary that information emanating from one common source is passed on. It is not necessary for reproductive relationships to be involved" (Eibl-Eibesfeldt, *loc. cit.*). What we know about dancing in apes is, while doubtless fascinating, unfortunately far from abundant, and even here a further discrimination demands to be promptly introduced, namely, as between studies of animals in captivity, some of which Sachs knew of, and observations of groups in the wild, which are of much more recent vintage. Both sets of data concern chimpanzees—the latter all but exclusively from the popular writings of Lawick-Goodall (for her dramatic descriptions, see, e.g., 1967: 75–77, 1971: 52–54; Nissen 1932, whose fieldwork was conducted during the dry season, occasionally alludes, nevertheless, to wild chimpanzees performing in parties).

Lawick-Goodall repeatedly refers to a display, which she reports having seen but three times in years, as a "rain dance". These group performances lasting almost half an hour, involved adult males—with females and youngsters in watchful attendance—although often individual males were also observed to "react to the start of heavy rain by performing a rain dance" (*id.* 1971: 54). It is not at all clear from Lawick-Goodall's description of these spectacles what the chimpanzees' behavior pattern could possibly signify. In the human context, what is commonly called a rain dance is performed in many societies as a fertility rite in order to produce rain; it belongs to a class Royce (1977: 207) calls metaphorical dances. By contrast, feral chimpanzees, to all appearances, "dislike the rain", reminding the observer of "primitive men … defying the elements" (Lawick-Goodall 1967: 74, 77). Their carnival display is in reaction to a sudden downpour. What we have here is a striking resemblance in form—sufficiently so, it seems, to account for the labeling—but a dearth of information about referential sign function, and therefore a gnawing question mark about the meaning of the convergence between man and chimpanzee in this arena of expressive movement.

Reports of chimpanzees dancing in the laboratory—including what Sachs (1937: 10) claimed to be the "most valuable document"—come from the psychologist Köhler (1922: 33–35; cf. *id.* 1925: 314–15), who was for six years in charge of a research establishment in Tenerife. Köhler frequently observed couples moving in dance-like fashion. He depicted a particular configuration about which he remarked (*ibid.* 33) that "Die Ähnlichkeit mit einem Tanz war besonders gross", a characterization Sachs wholly concurred with. Nor was this all. Stylized group dances took place, such as the following, which Sachs (*ibid.*) insisted "was a genuine round dance":

> In mock fighting two of them drag each other about on the ground until they come near a post. Their frolicking and romping quiets down as they begin to circle about, using the post as a pivot. One after another the rest of the animals appear, join the circle, and finally the whole group, one behind another, is marching in orderly fashion around the post. Now their movements change quickly. They are no longer walking but trotting. Stamping with one foot and putting the other down lightly, they beat out what approaches a distinct rhythm, with each of them tending to keep step with the rest. When two posts or boxes stand close to each other, they like to use these as a center, and in this case the ring dance around both takes the form of an ellipse. In these dances the chimpanzee likes to bedeck his body with all sorts of things, especially strings, vines, and rags that dangle and swing in the air as he moves about.

Sachs (1937: 11) identifies here the prefigurements of a series of basic human dance motifs: "as forms, the circle and ellipse around the post, the forward and backward pace; as movements, hopping, rhythmical stamping, whirling, and even ornamentation for the dance". Köhler (1922: 34) further tells us that the sympathetic observer would gladly join in this dance, and that when he initiated the movement around the post "in der besonderen Schrittart, welche für die Tiere dazugehörte", he was immediately followed by a couple of chimpanzees; but when he quit, because of fatigue, his dancing companions would squat and sulk. What Sachs (*ibid.* 12) is concerned with here ought to be taken very seriously, but remains as yet unresolved, for, as he summarizes: "If the dance, inherited from brutish ancestors, lives in all mankind as a necessary motor-rhythmic expression of excess energy and of the joy of living, then it is only of slight importance for anthropologists and social historians. If it is established, however, that an inherited predisposition develops in many ways in the different groups of man and in its force and direction is related to other phenomena of civilization, the history of the dance will then be of great importance for the study of mankind".

If one defines dance, in the stark fashion of Boas (1955: 344), as "the rhythmic movements of any part of the body, swinging of the arms, movement of the trunk or head, or movements of the legs and feet", then clearly the chimpanzees' behavior can legitimately be bracketed with ours. It is plausible, moreover, to regard both underlying structures homologous, implying that they owe their similarity to a common origin, much as laughter and smiling fit into the phyletic scale (cf. Sebeok 1979, Ch. 1). The postulation of a homologous relationship does not, however, necessarily imply a distinction between characteristics that are innate *vs.* those that may be acquired, for homologies may be passed on either via the genome or via memory, that is, by cultural or quasi-cultural mechanisms, in the manner, say, of song traditions in the parasitic weaver finches (*Viduinae*), which were discovered to even transgress species boundaries: these birds learn not only the songs but also the calls of their host species, and close mimicry of the vocalizations of the step-father results in parallel development which may, in turn, lead to eventual species genesis. Whether dance behavior is innate or acquired is not known, but it is important to be mindful that information may be communicated to a succeeding generation in several different ways, and therefore, since form depends on the function, convergence can hardly be excluded. In studies of expressive movements, the investigation is particularly complicated by the fact that the specific adaptations are not simply responsive to the environment, but involve subtle selective pressures which cannot yet be formulated in terms of physiological or biochemical correlates—for instance, a concept such as 'aesthetic pleasure'. Nonetheless, I find myself concurring with Griffin (1976: 78), when he exclaims that "this does not seem to [him] to be a sufficient reason for avoiding the concepts themselves, as though they were a dangerous plague". This view, moreover, accords, I think, with the line taken by such specialists in the dance as Hanna (1977: 211), who, while she feels "that the configuration of human behaviour that is called dance is significantly different from the behaviour of other animals, including that which has also been labelled dance", at the same time affirms "that human dance has its roots in phylogenetic and ontogenetic evolution, firstly in predisposing psychobiological processes and secondly in social experience".

2. Musical Signs

"Music", Merriam (1964: 27) tells his readers, "is a uniquely human phenomenon…"—but his generalization begs the very question that needs exploring. I would therefore prefer to start journeying backward in time from the Janus-like portal that is the sole rational means of access from nature to culture that Lévi-Strauss (1964: 24) sagaciously threw upon when befittingly noting that "la musique opère au moyen de deux grilles. L'une est physiologique, donc naturelle; son existence tient au fait que la musique exploite les rythmes organiques, et qu'elle rend ainsi pertinentes des discontinuités qui resteraient autrement à l'état latent, et comme noyées dans la durée. L'autre grille est culturelle; elle consiste dans une échelle de sons musicaux, dont le nombre et les écarts varient selon les cultures".

Boas (1955: 340) made two fundamental observations concerning music: first, that the only kind of music that occurs universally is song, "and the source of music must therefore be sought here"; and, second, that two elements, and only two, are common to all song: rhythm and fixed intervals. It is in the class of birds that the root-stock lies to which these remarks must inevitably lead the unprejudiced investigator, fortified by the opinion of so experienced an ornithologist as Thorpe (1974: 307), who, in repudiation of a typically naive remark of Suzanne Langer's,[3] proclaims his own stand: "…increased familiarity, from long study, certainly for me, increases my conviction that our judgment that bird songs, in some instances and in some degree, represent music is not mistaken".

Within the last decade, several competent and thoughtful studies have appeared appraising a field that in the course of its recent development has even won a name of its own: ornithomusicology (Szöke 1963). One such survey, on the aesthetic content of bird song, was compiled by Hall-Craggs (1969), a British ornithologist. Another, a book-length global reinterpretation of bird song, was undertaken by Hartshorne (1973), a prominent philosopher (perhaps best known to this readership as the senior editor of the *Collected Papers* of C. S. Peirce). As for the controversial but hardly verifiable central thesis of ornithomusicology—an idea first articulated, I believe, by Montaigne—it is argued that birds evolved elaborate musical utterances long before the appearance of man, who may be supposed to have derived his primitive music under the instigation or, at any rate, influence of their song: men certainly heard it and some may have imitated it. (It should be mentioned here that man often mimics different aspects of animal behavior,[4] and particularly that the imitation of bird dances is quite widespread. One example from Europe is the incorporation of a figure, the *Nachsteigen*, from the behavior of the mountain cock, into the Bavarian *Schuhplatter;* see further Armstrong 1965: 209ff.) The process of adoption would have been facilitated by the undeniable fact that man and bird share certain requisite physiological foundations: both of us sense the world most consequentially by optical means, and both of us address it most saliently by acoustic means.[5] Indeed, in a number of crucial respects, and particularly as to the predisposition of some song birds, manifesting critical periods in their

---

[3] Thorpe dismisses Langer's absurd view that the singing of birds, being 'unconscious', is not art. For a critical consideration of her writings on music, see further Henle (1958: 202–20).

[4] Linguists will recognize this observation as a generalization of the so-called 'bow-wow theory' of the origin of speech, supposed to have arisen as a consequence of onomatopoeia.

[5] This notwithstanding, there are also profound differences, since song birds possess twin sound-producing organs—one in each bronchus—whereas in man, as indeed in all mammals, there is but a single vocal source. Our understanding of the acoustical

lives for song-learning, to master certain sounds rather than others in a manner reminiscent of the kind of constraints on first language acquisition detectable in human children, and in several other important respects, "these birds are closer to man than any nonhuman primate…" (Marler and Gordon 1968: 128).[6]

Were the ornithomusicologist's contentions demonstrable, then one could postulate a true homology of tradition, if not a phyletic one: human song would thus be as homologous to bird song as, say, a genetically unrelated second language acquired by a foreign speaker is homologous to the first language learned by a native speaker of that same language. Failing that, we must fall back on the principle of convergent evolution, justified by adequate evidence for formal correspondence. But Szöke's line of argumentation is by no means abrogated or contradicted by the prodigiously erudite Armstrong's (1963) chapter on "Bird Song as Art and Play", where this English life-long student of bird behavior repeatedly remarks that "As evidence increases it becomes more difficult to deny that birds possess some aesthetic sensitivity" (*ibid.* 267), that "we are justified in postulating the existence of aesthetic appreciation on a lower level among animals" (*ibid.* 235), and that, "whatever else our aesthetic taste may be, it is an extension and refinement of animal abilities" (*ibid.*). He quotes an apt observation by Paracelsus, the early 16th century physician and alchemist, who admonished: "Man need not be surprised that animals have animal instincts that are so much like his own. … Man may learn from the animals, for they are his parents".[7]

The most elusive problem in demonstrating "that birds have aesthetic taste is the difficulty of proving that any characteristic of bird song is non-utilitarian" (Armstrong 1963: 244). Hartshorne's book (1973, esp. Chs. 2 and 3) is in part addressed to this predicament, which he formulates thus: "To say 'aesthetic' is to say 'not merely or too directly utilitarian'. But we must be careful to balance this consideration against the seemingly contradictory one that unless an aesthetic activity has some connection with utility it will be unlikely to survive

---

and physiological processes involved in the singing of birds is as yet very far from satisfactory. For details, see the excellent but neglected work of Greenewalt (1968).

[6] Cf. Nottebohm's remark (1972: 133) that "The gap separating human vocal exploits from those of other primates is enormous". The same investigator is principally responsible for the dramatic discovery of lateralization of vocal control in several song birds, notably the canary, in the brain of which localization of vocal control was found with an overlying left hemispheric dominance (*id.*, Stokes, and Leonard 1976). Vocal learning is thus a trait shared by bird and man, with, perhaps, a very few other species.

[7] Cf. also the comment of two anthropologists, cited in Wescott (1974: 288), "emphasizing bird-song both as an analog to and a model for human song…".

evolutionary change" (*ibid.* 53). Hartshorne speculates that there may be an optimum here between irrelevance to survival needs of the species—notably, as an expression of its territorial requirements (the birds with the 'best' songs are usually the ones with the most marked territorial behavior)—and too close or immediate a connection with such needs, as represented by the individual singer in a given context. He postulates "a safety factor", a sort of emergency valve for the outlet of surplus energy, a luxury activity that can always be nullified in exigent circumstances.

Rhythm is the basis of form in bird song, as in all music, much as symmetry is in space or equilibrium in matter. Hall-Craggs (1969: 311ff.) discusses its prevalence in some detail, as well as of the transposition of fixed intervals that Boas deemed the second all-important element of music, comparable with melody. Armstrong (1963: 244) remarked earlier that "it can hardly be fortuitous that some birds do sing and transpose in accordance with our musical scale". An important series of experiments bearing on this point was carried out by Reinert (1965) with jackdaws (*Corvus monedula*). After being conditioned to distinguish certain rhythmic acoustic signals, the jackdaws were able to identify them even when played by different instruments, that is, with a different timbre, or when the tempo, pitch, or interval are transposed. They could also distinguish between two-four time and three-four time. The birds could perceive acoustical patterns differing in intensity and duration of tone, and recognized a great many variations. In sum, they did not depend on absolute clues only but, as we ourselves, do in the perception of phonemes, on relative ones. Ultimately, I suppose, this is a mathematical matter, and eventually Nelson (1973), in fact, undertook a sophisticated quantitative comparative study of this kind, showing similarities of structuring in several taxa, including behavioral organization in bird and man, with respect to acoustic signals.

Many birds, moreover, possess the ability to follow a train of changing pitches, as a scale, and to distinguish it from another train proceeding simultaneously but at a different speed or in a different direction. In other words, these birds appear to have solved what Cherry (1978: 279–282) had designated in man as the "cocktail party problem", the essence of which I take to consist in the capacity to select one particular acoustic string, viz., a tune, out from its accompaniment or to distinguish it from another string proceeding at the same time (polyphony). A single individual veery (*Hylocichla fuscescens*) is, for example, able to produce complex polyphonic patternings; nor need there be, in this species, an interval between primary patterns, although it may be present in one voice but not in the other. "At the end of most songs, the two voices come together to cooperate in a characteristic extended trill of *overlapping arpeggios* (song *A*); sometimes this 'cadence' appears to be left to the lower voice alone (song *B*)" (Nelson 1973: 288–89). Thorpe, on the basis of his distinguished fieldwork, supplemented by laboratory studies, has clearly confirmed the existence of "something like musical appreciation, albeit on an elementary scale, existing in a good many birds" (1974: 205), derived, in part, from discoveries of antiphonal singing, especially in the compulsively duetting African shrike (*Laniarius aethiopicus*) (Thorpe 1972). The notes of the duet constitute polyphonic singing, such that the pitch, timing, and phrasing can, to a large extent, be controlled very exactly, but can also be varied by the singers. Either sex can start and the other finish, either bird can sing the whole pattern alone if the partner is absent, and, when the partner returns, the two birds can either duplicate in perfect time or resume antiphonal singing.

The organized singing patterns of birds have long attracted our attention. In some, the singing is organized to conform with strict sequencing rules; the structure is hierachical, the levels comparable with the build-up of the human mode of vocal display. Ethologists tend to interpret bird song in terms of the adaptive advantages it confers on the performers and their conspecific audience, while keeping an open mind on the ramifying consequences of the display, which may well surpass a single function and come to encompass the aesthetic dimension. To summarize: "That birds 'sing' is a notion applied popularly to vocal performances that people find aesthetically pleasing, but singing lacks a fully accepted and rigorous descriptive meaning in ethology" (Smith 1977: 56).

The ornithomusicological hypothesis becomes muddled when one considers that other animals than birds have variously been alleged to 'sing': "Cicadas [i.e., locusts] are noisy, daytime musicians, the male alone singing. The sound is produced by snapping a special structure, the tymbal, with a muscle" (Frings and Frings 1977: 79). As with birds, singing is emulative, and this, as Darwin (1901: 434) had noted, sometimes gives rise to antiphonic duets or trios. This application of 'song' is, however, likely to be metaphorical just as 'dance' is in application to the honeybee. Then there is the California singing fish (*Porichthys notatus*), whose song, which varies in tone pitch and quality from specimen to specimen, produced under conditions of colonial activity, was carefully described by Greene (1924). The striking vocalizations of frogs and toads have also been termed 'songs' (Frings and Frings 1977: 179), often in reference to the existence of duetting throughout some nineteen genera, or more complex chorusing behavior, the biological function of which has hitherto eluded all investigators. The bellow of the alligator, assumed to convey an assertion of dominance and a challenge to other males within earshot, is likewise often called 'song' in the reptile literature.

I personally doubt if phenomena of this sort can be considered as prefigurements in any interesting sense. However, there are at least two groups of mammals in which singing has been reported, and these may be worthier of our regard.

First, there is the case of the humpback whale (*Megaptera novaengliae*), a species whose phonograph recordings have received considerable publicity in the media and on at least American college campuses during this decade (George Crumb's exotic composition, "Vox Balaenae For Three Masked Players", was directly inspired by the voice of the whale). Mysticete sounds have for some decades been recognized to be varied and complex, but the humpback is the baleen whose rich sonic repertoire has been most thoroughly studied so far (Payne and McVay 1971). The animals certainly "emit a series of surprisingly beautiful sounds" (*ibid.* 587), including a long train, called a 'song', that recurs in cycles lasting up to 30 minutes and perhaps longer. This song is often produced in continuous soliloquy, very loudly, by a single whale for a full eight minutes; there is no evidence of duetting. But its purpose is not really understood; "we can only guess what function this remarkable series of vocalizations serves" (*ibid.* 597). This being so, no one can yet say whether the performance has, for the whale—in contrast to the human listener—any sort of aesthetic significance, and thus whether the designation 'song' is biologically justified.

The climactic question whether song-like behavior has been observed in the order of Primates can be answered affirmatively, but, among the monkeys, it seems, only for some platyrrhine (New World), species, notably, *Callicebus moloch* (titi monkey). In the case of this monkey, Moynihan (1966: 119) applies the term song "in a very broad and general sense, to include all series of notes uttered in more or less rapid and regular succession and distinctly set off, by relatively long pauses, from both preceding and succeeding notes". Moynihan characterizes such passages as only moderately rapid throughout all or most of their length, and these he calls "ordinary" songs. He describes four or more other types, and calls these "compound" songs. Among the ordinary songs, he identifies nineteen, but says that this list is certainly not exhaustive. He terms two of the most common compound sequences "full" songs; in these, the normal sequence of pitch changes is from higher to lower, irrespective of the actual notes involved. He explains why they cannot be produced by precisely the same type of motivation—there are qualitative as well as quantitative differences in causation. Full songs of one individual frequently instigate full songs by others.

When two or more individuals are within twenty or thirty feet of one another, their songs tend to be very closely synchronized, note by note; synchronization usually breaks down as the distance between individuals increases. This sort of timing probably has one important advantage, to enable singing individuals to judge, with very great precision, their relative positions vis-à-vis one another. Like most song birds, which display an intense dawn chorus, the titi monkey typically vocalizes at daybreak: "All or almost all the adults … begin to sing as soon as it starts to become light, well before sunrise. Their Songs usually are long and full, including (at least) Moans, Resonating Notes and Pumping notes. … Dawn Songs probably are seldom or never reactions to external stimuli. … They do not appear to have any direct or immediate signal function, insofar as they seldom or never provoke obvious responses from other individuals (except, sometimes, singing in return)" (ibid. 120). Most of the major components of the *Callicebus* song repertory is assumed by Moynihan to be homologous with that of species in many other genera, occasionally all.

In general, the vocalizations of catarrhine (Old World) monkeys, and especially those of tailless apes, deserve much closer study. Marler and Tenaza (in Sebeok 1977: 970) have recently stressed that "a comprehensive acoustical description" of the chimpanzee—which has been studied far more than any other ape—"has yet to be published". With respect to singing behavior, the gibbon may be the most interesting animal of all: as long ago as the 1890s, Blanford (1888–91: 7), a well-known authority on South Asian mammals, wrote about the hoolock (a species of gibbon found in Assam and Upper Burma), that its powerful voice, at a distance, "much resembles the human voice; [its song] is a peculiar wailing note, audible afar, and … one of the most familiar forest sounds. The calls commence at daybreak, … several of the flock joining in the cry, like hounds giving tongue. … [They] remain silent throughout the middle of the day, but recommence calling towards evening, though to a less extent than in the earlier part of the day". This is another example of the diurnal rhythm that so frequently characterizes song displays. The same term, 'song', is also used for the hoolock and several other varieties of gibbon by Marler and Tenaza (*ibid.* 1001–09), who distinguish three kinds of choruses based upon the sex of the singers: those consisting entirely of males singing; those consisting entirely of females singing; and those consisting of duets sung by mated pairs of gibbons. They describe individuals engaged in dyadic countersinging with adjacent neighbors in several species. Predawn chorusing occurs very frequently, with choruses beginning as early as five hours before sunrise. This separates them temporally from dawn bird choruses, and it is assumed that the timing is an evolutionary consequence of interspecific competition for the auditory environment. "Captivity seems to have no effect upon the song structure or the nature of duetting in gibbons", according to these authors (*ibid.* 1008). In conclusion, Marler and Tenaza supply a long list of unanswered questions about pongid signaling behavior, insisting that, "Above all, new approaches should be sought to characterize the *functions* of different vocalizations, so that more subtle interspecies comparisons of the proportions of a signal repertoire devoted to different kinds of adaptive tasks may be possible" (*ibid.* 1029). Considering, therefore, the uncertain state of knowledge about the biological uses of what is nevertheless persistently called ‘song’ in the alloprimates, it seems premature to probe for its aesthetic function, if any.

In concluding this section, and before turning to the representational arts, I should mention that there are birds, among some sixty species of the family *Pipridae*, that *both* sing *and* dance, each species according to its own ritual. Even the earliest explorers of South and Central America noticed them because of their unique dances and the music connected with these dances, as in this entrancing description by Nutting (in 1884; from Slud 1957: 333): “Upon a bare branch which overhung the trail at a distance of about four feet from the ground, two male ‘Bailadors’ were engaged in a ‘song and dance’ act that simply astounded me. The two birds were about a foot and a half apart, and were alternately jumping about two feet into the air and alighting exactly upon the spot whence they jumped. The time was as regular as clock-work, one bird jumping up the instant the other alighted, each bird accompanying himself to the tune of ‘to-lé-do–to-lé-do–to-lé-do’, sounding the syllable ‘to’ as he crouched to spring, ‘le’ while in the air, and ‘do’ as he alighted”. In Costa Rica, where this enchanting bird is known as *el toledo*, people tell the same story in almost exactly the same words while alternately raising each index finger to illustrate the quaintness of the performance. The bird is technically known as *Chiroxiphia linearis* (one of the four so-called Chorus species), or the Long-tailed Manakin, whose antics were recently described, with some variations, anew by Slud (1957). All observers agree that the males do dance and that the *tolédo* call is a constant accompanying feature, although their views differ as to some other details. Slud vividly recounts several distinctive calls associated with the actively dancing males, including the “unmistakable *tolédo*”, and characterizes the bird’s flight as butterflylike: “They fly with the weightless bounce of a Morpho”, adding: “I am at a loss to explain the mechanics by which the slow beats somehow sustain the retarded flight” (*ibid.* 336-37). Their aery floating can by no stretch of the imagination be interpreted as a leaping back and forth from branch to branch. Of the dance, he further says: “Perched crosswise a foot or two apart, both facing in the same direction, the two birds alternately rise straight into the air for a foot or two. Each fluttering rise is preceded by a lowering of the head, and at the top of the rise the bird hangs suspended for an appreciable pause, as though attached to a rubber band. The red crown of the bowed head appears unusually large and bright, the sky-blue back loosely fluffed, the long tail arches and hangs in a graceful curve, and the bright orange legs hang too. A guttural *miaow·raow* punctuates each rise. Gradually the duration of each rise shortens and the rate of successive rise increases. As the tempo mounts, the crest of the risings falls lower and lower and the pitch of the accelerating *miaow·raow’s* rises higher and higher until the former degenerate into seemingly uncontrolled flutters and the latter into unintelligible buzzy sounds. Now the birds hardly rise at all and almost bump each other as they flop about like helpless victims of an internal disorder. As though a switch were pulled, the orgiastic frenzy ends suddenly, and the birds cock their heads innocently in calm possession of faculties restored at the instant of reassertion of self-control" (*ibid.* 337). Slud also depicts an alternate dance, which begins after the same preliminaries as the preceding one. "This time, however, the birds stand on the vine or branch lengthwise, both facing in the same direction but with one behind the other, again spaced more than a foot apart. The first bird, uttering his *miaow·raow*, rises straight into the air, where he then hangs momentarily suspended. As he reaches the top of his leap, the rear bird, crouched, his eyes fixed upon the bird in the air, with rapidly flicking wings and arched tail hitches himself forward to the accompaniment of a low ticking, *pk·pk·pk·pk·pk* etc., to a point on the branch directly below the suspended bird and identical to the one from which the first bird rose. The bird in the air now falls diagonally backward to the very spot from which the bird began his ticking, wing-quivering creep. As he alights, the second bird, now in the forward position, rises into the air. At the same instant the first bird, fallen to the rear position, hitches himself forward in his turn. Like balls in a juggling act, the birds replace one another with cyclical regularity. The individually uttered *miaow·raow's* accent the recurrent rhythm and the underlying ticking goes on almost without interruption. The tempo may be increased but the performance does not become disorganized as in the straight up-and-down dance. … The dance ends suddenly and the birds float 'butterfly-like' to the sidelines" (*ibid.* 337–38).

3. Pictorial Signs

You have already been introduced above to bowerbirds, a group about whose 'artistic' productions no less a scientist than Karl von Frisch (1974: 244) has said that it has "much similarity with human behavior in comparable situations: those who consider life on earth to be the result of a long evolutionary process will always search for the beginnings of thought processes and aesthetic feelings in animals, and I believe that significant traces can be found in the bower birds". He (*ibid.* 243–44) goes on to quote a wondrous observation by the naturalist Heinz Sielmann about the decorating behavior of a New Guinea species, the Yellow breasted bowerbird (*Chlamydera lauterbachi*): "Every time the bird returns from one of his collecting forays, he studies the over-all color effect. He seems to wonder how he could improve on it and at once sets out to do so. He picks up a flower in his beak, places it into the mosaic, and retreats to an optimum viewing distance. He behaves exactly like a painter critically reviewing his own canvas. He paints with flowers; that is the only way I can put it. A yellow orchid does not seem to him to be in the right place. He moves it slightly to the left and puts it between some blue flowers. With his head on one side he then contemplates the general effect once more, and seems satisfied". Even though Marshall, who, after more than two decades' of study, became the foremost authority on bowerbirds, had indicated, or tried to, a utilitarian basis for all such seemingly artistic manifestations, he summed up his findings thus (1954: 185–86): "…I see no reason, provisionally, to deny that bower-birds possess an aesthetic sense although, it must be emphasized, we have as yet no concrete proof that such is the case. Some bower-birds certainly select for their displays objects that are beautiful to *us.* Further, they discard flowers when they fade, fruit when it decays, and feathers when they become bedraggled and discoloured. … The fact that some bower-birds select objects that appeal to man's sense of beauty is no proof that such articles have a similar effect on the bird. If all bower-birds made collections of bleached bones, less would be written of aestheticism. Yet nobody would suggest that its pile of dry bones and dead snail-shells is less beautiful to [the Great Gray bowerbird] than is the 'beautiful' array of blue and red berries to [the Yellow-breasted variety]. It would, of course, be unthinkable to suggest that bower-birds—or any birds for that matter—do not get pleasure from the vocal, architectural, and other activities they perform but whether such pleasure has much in common with that of Man, engaged in comparable pursuits, has yet to be proved". At any rate, a scientist of the stature of Haldane (1956: II: 11) was convinced that "a few animals, such as bower birds, show *sundaradharma*, behaviour satisfying aesthetic needs. This is most marked in the bower birds…". Nor does it seem surprising, in the light of conclusions such as this, that Odoardo Beccari, the first naturalist to discover the display court of a bower-bird, should have believed that he had stumbled upon a playhouse built by native children!

Over and over, we keep encountering the same pivotal aesthetic paradox: this emerges from a profound confusion about purpose; it drives us to compulsively ferret out any semblance of utility, usually defined as adaptive value.[8] We find it difficult to conceive of art as a coherent part of animal life and can scarcely imagine it as an adornment of their leisure. All researches in this field are stamped by a tension between a deeply felt conviction on the part of many distinguished and sensitive biologists that artistic activity indeed exists in the

---

[8] So already in Romanes (1892: 410): "All cases where beauty can be pointed to in organic nature are seemingly due … to utility".

animal world and the inability to face its presumed lack of importance, even uselessness. More generally, Jenkins (1958: 130) has argued that the position assigned to the aesthetic life in Western culture, from Plato onwards, is imbued by an uneasy fluctuation between these two attitudes, "that art is at once useless and fraught with significance, purposeless and yet important". The two poles Jenkins speaks of are perhaps reconciled in a casual comment of Vygotsky's (1971: 246): "Apparently the possibility of releasing into art powerful passions which cannot find expression in normal everyday life is the biological basis of art". Viewed thus, art becomes a kind of cybernetic device for keeping the organisms' *milieu interiéur,* or to use Uexküll's corresponding concept, *Innenwelt* (Sebeok 1978b, Ch. 10), in balance with its surroundings (*milieu extérieur*, or *Umwelt*).

Art, in this homeostatic sense, is surely recognizable in many other biological systems than man. Birds that construct elaborate nests, such as the weavers, build improved nests in their second season, after having practiced during the previous one, now opting for habitations which are 'better' in the sense of tidier, neater, more elegant, but not at all demonstrably more useful. One may well ask with the late Waddington (in Brothwell 1976: 8), "is it then or is it not an aesthetic 'better'?" Spiders will repair damage made to their webs, but "it is debatable whether this repair is governed solely by utilitarian consideration" (*id.*). The webs of certain drunken or drugged spiders appear both, one assumes, to them, and certainly to us, very unappealing. And chimpanzees and gorillas, when offered the materials used by human artists, "which are obviously exceedingly unnatural and exotic in relation to a normal primate life, produce paintings and drawings in which some aesthetic qualities may perhaps be discernible" (*id.*). This is the topic of a recent overview article by Whiten (in Brothwell 1976, Ch. 2), himself a practicing painter. Before, however, turning to ape aesthetics, I should at least mention Dücker's (1963) interesting work on color preferences of forty-two specimens of birds of different families, in eleven species, especially spotted weaver finches. Animals have an innate positive and/or negative feeling-tone for particular colors, or patterns; commonly this is related to species-characteristic signs that serve as releasers triggering their responses to each other. The males of many song bird species, Dücker showed, tend to exhibit a preference for the distinctive coloration of their own sex. Rensch (1976: 329) found that a green long-tailed monkey (*Cercopithecus aethiops*) favored white, a color which also occurs in the bare skin around the eyes of these monkeys "and is evidently a signal stimulus for the recognition of their own species". Rensch, who had performed several thousand tests with two species of monkey, also reports that, when such innate color triggers are eliminated from the experiments, "higher animals are still found to show some preferences which correspond to the basic aesthetic feelings in man". His monkeys showed a distinct predilection for bright colors over shades of gray, just as human children do. He speculates (*ibid.* 330) that the probable reason for this is "that the stimuli which are associated with the sensations of colour and which are generated in the cones of the retina are more powerful than stimuli generated in the rods, which respond only to varying degrees of light and dark, i.e., to different shades of gray. Besides, colours usually stand out more distinctly from their background than grays do and are therefore more easily discernible".[9]

Schiller's study (1951; published posthumously, reported by K. S. Lashley) of more than 200 of Alpha's drawings was a landmark among researches of visual composition in apes. Her drawings, Schiller found, in no case yielded representations. He compared them, in this respect, to scribblings of the human infant from twelve to eighteen months. Nor did he find any evidence of imitative drawing. One feature of interest that emerged was that Alpha's drawings, like those of the Kohts chimpanzee, Joni, underwent a considerable change of style over the six months of nearly daily tests. Twenty months later, however, Alpha returned to her original style. The reason for these fluctuations was not determined. The drawings showed a distinct sense of design and the ability to develop a pattern, including an impressive indication of a tendency for symmetrical arrangement. Schiller felt (*ibid.* 109) that this argued "strongly that Alpha has some feeling for a balance of masses on the page". He believed that she was less interested in the effects of her drawings as in the action itself: "She is not influenced by the color of the figures or background or the visibility of her markings. Pencil lines drawn on or around the figures by the experimenter do not influence the position of her scribblings. She pokes toward the figure with the crayon, exploring its outlines and interior. If she gets an edge loose, she tries to peel the figure off of the sheet" (*ibid.* 110). Schiller also perceived another factor at work: "She does not draw with a pointed stick and discards or chews up the crayon when the point breaks and it no longer marks. Given paper and pencil with broken point, she retires to a corner, examines the point, makes a few tentative strokes, then returns to the front of the cage to beg. The fact of marking is thus an essential part of the activity" (*ibid.*). It is, incidentally, worth noting that Alpha was never given any kind of a reward—either food or social—for drawing; Schiller held that she got her reinforcement from the very act of drawing.

Morris (1962) discusses the results obtained with Alpha, and compares them with those of his mascot Congo, the second ape artist to be studied in depth.

---

[9] See Davis (1974: 216–19) on the complexities of the neurophysiological mechanisms of encoding color and form in monkeys.

Congo's responses were found to be comparable, when given like tests, with those of Alpha; similar behavior has also been observed in other great apes, and in a capuchin monkey who drew lines on the floor of his cage when he was presented with color chalks (Bourne 1971: 222, Rensch 1976: 339).

Several gorillas, from Rotterdam and Basel to Palo Alto, have been known to draw and paint very successfully, as have occasional orangutans. In the mid-1950's, an ape known as Baltimore Betsy became famous from her fingerpaintings. Her work, and those of two other apes, were shown, without identification, to child psychiatrists. "One of the psychiatrists interpreted them as coming from an aggressive seven- or eight-year-old boy who had paranoid tendencies. Baltimore Betsy's drawings were said to be from a fiercely belligerent ten-year-old schizoid girl. A second picture by the same animal was also said to be by a ten-year-old girl who was paranoid and showed a strong father identification" (Morris 1962: 25, Bourne 1971: 224). Eventually, twelve paintings by Betsy as well as twenty-four Congos were exhibited—and practically all sold—in London. Julian Huxley, who had opened the exhibition, later made the following comments: "The results show conclusively that chimpanzees do have artistic potentialities which can be brought to light by providing suitable opportunities. One of the great mysteries of human evolution is the sudden outburst of art of a very high quality in the upper Paleolithic period. This becomes more comprehensible if our apelike ancestors had these primitive aesthetic potentialities, to which was later added man's unique capacity for symbol-making" (from Morris 1962: 27).[10] Morris recapitulates in his justly famous book half a century's picture-making with twenty-three chimpanzees, two gorillas, three organgutans, and four capuchin monkeys. Alpha and Congo, who produced some 600 pictures in all, were studied most intensively. The principle that Morris stresses and elaborates (1962: 144ff.) is the fact that painting involves actions which are self-rewarding activities, that is, they "are performed for their own sake rather than to attain some basic biological goal. They are 'activities for activities' sake', so to speak". In human art, this sort of motivation has appeared in many guises. Jenkins's (1958: 126–27) roll-call includes such celebrated

---

[10] The animal paintings at Lascaux, Altamira, and other famous decorated caves of the Upper Paleolithic (c. 35,000 to 10,000 B.C.) do not seem to me directly related to the issues discussed here. The prehistoric art forms of the last Ice Age—which, it is now known, include remarkably life-life engraved 'portraits' of men and women, as well as elaborate musical instruments, such as a percussion orchestra of six pieces and the six-stop flutes excavated one at a Ukrainian site and another, dating from the same period, in France—are far too sophisticated to be productively compared with ape art.

aesthetic doctrines as “detachment, catharsis or purgation, isolation, objectification, emotion remembered in tranquility, psychic distance, self-surrender, passivity, pure perception, will-less knowing, reposefulness, equilibrium, synthesis, impersonalness, contemplativeness, empathy, pleasure objectified, disinterested pleasure, receptivity”, and many others echoing the same meaning. For Morris, the category of self-rewarding activities is essentially biological, of course: “Most of them are basically physical, meteoric outbursts and are fundamentally similar to human gymnastics and sports, except that they lack any ulterior motives such as the obtaining of health, money, or social standing. They may inadvertently keep the animal mentally and physically healthy and thus indirectly assist in its struggle for survival, but the actual driving force behind these self-rewarding activities appears to be simply the unleashing of surplus nervous energy” (*ibid.*). This immediately suggests a central question: why, if they have such a strong picture-making potential, have apes neither developed nor utilized it in the wild? This question corresponds closely to a second one, far more widely debated these days: why if, as alleged, apes have the cognitive prerequisites for the acquisition of language competency haven’t they elaborated it in nature? No satisfactory answer to the latter question has been put forward thus far; even the rankest activist hasn’t proposed that they have done so, outside of science fiction of the likes of Jules Verne and on the planet of the apes. Morris’s answer to the former rests on his claim that, as soon as man “had a real language which described objects as well as moods, the gateway was open to the pictorial representation of these objects” (*ibid.* 146), or, in other words, that the emergence of this averbal art required the antecedence of verbal signs. This suggestion may appear likely to some, although I personally doubt it and, in any case, it is entirely speculative.[11] More to the point, it sheds no light at all on the previous conundrum. The holistic interpretation of pictures is a function of the right hemisphere, an operation normally exercised in conjunction with the left hemisphere; but the minor hemisphere, which seems specialized for dealing with things all at once, has an extremely limited verbal capacity, even though its performance is said by Eccles (Popper and Eccles 1977: 328) to be “superior to

---

[11] Ferguson (1977: 835) has recently documented convincingly that much of the creative thought of the designers of our technology is nonverbal, nor is it easily reducible to words. The importance of his article lies in the fact that the origins of this component of technology lie not in science but in art. McNeill (1973: 91) has cogently remarked that even if free-ranging chimpanzees had indeed evolved a capacity for language-like communication, “we should not expect it to resemble human language…”. This view accords with the opinion of Washburn (1978: 410) about apes in general, that “the structure of their natural communications will be like that of monkeys”.

that of the brains of the highest anthropoids", while the dominant hemisphere, which tends to deal with things in sequence, is "almost illiterate in respect to pictorial and pattern sense" (*ibid.* 351).

Morris adduces five further biological principles of picture making beside the basic one, that the accomplishment is in and of itself rewarding. His second principle is that of compositional control, the power of which is illustrated by Alpha's and Congo's adherence to the simple rules of filling a space and keeping within it, balancing, and cadenced repetition. This was previously evidenced from Rensch's investigations with a capuchin and a guenon monkey, and found, as well, in jackdaws and crows. As Morris (*ibid.* 161) notes, the vital words here are: "steadiness—symmetry—repetition—rhythm". His third principle, "calligraphic differentiation", is a developmental one, referring to a slow progress of pictorial growth, which, however, is less strikingly exhibited by apes than by children. It is closely related to the fourth principle, thematic variation, or, as we might say in semiotics, the concept of invariance with allowable reformulations.

Whiten rightly regards the last two principles—which the proponent himself had put forward merely as a working hypothesis—of dubious status: "optimum heterogeneity", Morris suggests, governs the composition and point of completion of each picture, meaning by this the stage at which the picture is considered to be finished. Congo, it seems, had a very distinct concept of when a drawing or painting of his came to an end. By contrast, Alpha continued to cover the whole sheet with scribble if the paper was not removed. "Universal imagery" is what gives ape pictures as a whole a recognizable character, Morris finally maintains, but the only image which seems to recur with any regularity (also in capuchin art) is the "fan".

Whiten (*ibid.* 32–40) moves beyond the problems of artistic creation that had preoccupied Morris to those of aesthetic appreciation, relying, in the main, on several papers by Humphrey (1971, 1972). Humphrey's initial series of tests was designed to determine if monkeys had favorite colors and preferences for certain brightnesses. The four monkeys tested for color gave the same result: the order of preference in each case was blue, green, yellow, orange, and red. Brightness preference, which was tested by pairing the standard white slide with white slides of differing brightnesses, turned out to be monotonically related to brightness over the range used.

Next, Humphrey tested preferences for pictures, using thirty colored photographs classified as 'men' (e.g., a portrait of the keeper), 'monkeys' (two infants playing), 'other animals' (cow), 'foods' (banana), 'flower' (daisy), and 'abstract painting' (a Mondrian). This order of preference turned out to be: other animals/monkeys/men/ flowers/abstract painting/food.

One may well ask, with Whiten (*ibid.* 37), "whether such preferences have anything at all to do with aesthetics". Humphrey posits two different patterns which reflect a dichotomy as to the ways both we and monkeys may exploit our senses: we may, he affirms, look at a stimulus "purely for pleasure" or "purely for interest". The pleasure dimension, corresponding to a pure aesthetic, can be either positive or negative, but is little affected by novelty, whereas the curiosity dimension is positive and changes only toward indifference as the novelty of the stimulus wanes. In Humphrey's view, the two types of responses operate quite independently, although they often coalesce as to timing, in which case their combined effects will yield a summative expression of preference. Humphrey resumes his findings in five simple principles, to wit:

1. Two independent kinds of relationship obtain between the monkey and the stimulus, called 'interest' and 'pleasure/unpleasure'.
2. When there is a choice between two stimuli, the monkey ranks them according to their relative interestingness and relative pleasantness.
3. If one stimulus is 'appreciably more interesting' than the other, the probability that the monkey will prefer it is 1.
4. If one stimulus is 'appreciably more pleasant' than the other, the probability that he will prefer it is 1 unless the other stimulus is appreciably more interesting.
5. If neither stimulus is either appreciably more interesting or pleasant, the probability that he will prefer each is 1/2.

Unfortunately, these principles were derived from monkeys, not apes, but Humphrey was able to predict from his quantitative model with a high degree of accuracy preferences for a stimulus which combined the two distinctive features of interest and pleasure. Visual feedback, we may safely surmise, is an important part of painting for apes, but we can't be sure—and the question still abides why their desire to create visual art remains latent, to surface, if at all, only in captivity, whether spontaneously or under instigation.

Another puzzle which continues to perplex has been well posed by Whiten (*ibid.* 39), who wonders, "why has nature equipped the chimp and the human with such ability? The interest or curiosity dimension of art can be seen as an offshoot, functionless in terms of survival value. … But if a pure aesthetic sense is a functional offshoot of some other functional attribute, what is this?" Humphrey (1973) has wrestled with this difficult question himself, and I find this animal behaviorist's suggestions particularly intriguing because he believes, as I do, "that a structuralist approach is the key to the science of aesthetics" (*ibid.* 430), and because he has so fruitfully employed semiotic concepts. Like Lévi-Strauss's, whom he cites, his starting point is a conceptualization of an artistic product as a system of signs, but from this obvious notion he goes on to ask how such works acquire their artistic charge. The answer he proposes (*ibid.* 432) is that, "considered as a biological phenomenon, aesthetic preferences stem from a predisposition among animals and men to seek out experiences through which they may *learn to classify* the objects in the world about them. Beautiful 'structures' in nature or in art are those which facilitate the task of classification by presenting evidence of the 'taxonomic' relations between things in a way which is informative and easy to grasp". This argument, of course, presupposes that the capacity for effective classification is important for survival, perhaps on a par with eating and sex. If so, techniques of classification were bound to evolve so as to be a source of pleasure to the animal and thus to shape the non-random differential reproduction of its genes (natural selection). After all, as Humphrey remarks, both animals and men can be relied on to do best what they most enjoy doing. This point of view, coupled with the idea that no work of art is arbitrary, suggests where an animal's feeling of beauty may come from. In the terminology of René Thom (1975: 316), "the work of art acts like the germ of a virtual catastrophe in the mind of the beholder". 'In other words, although art is always unpredictable, "it appears to us to have been directed by some organizing center of large codimension, far from the normal structures of ordinary thought, but still in resonance with the main emotional or genetic structures underlying our conscious thought".

Humphrey carries his taxonomic metaphor much farther, enriching it with the notion of rhyming, or, as I would prefer to denominate the phenomenon more generally, parallelism. He brings experimental evidence to bear from a rich array of studies of exploratory behavior, and from his own investigations of "stimulus novelty" in monkeys. Parallelism involves the psychological notion of "stimulus discrepancy", or what in the early 1950s was called "discrepancy theory", ugly coinages for a fundamental concept with wide applications in the animal world and among human babies.

The propensity to classify seems to have acquired, through evolution, diminishing survival value, but then so did sex: humans can enjoy either, but most *tokens*, though pleasurable *per se*, are not biologically relevant. Only the *type* of activity has a clearcut biological function.

Finally, let it be noted that Humphrey's pleasure principle seems equivalent to Morris's principle of composition. Pleasure, more likely than curiosity, tends to motivate compositional control, but the reverse holds for calligraphic differentiation and thematic variation. To some extent, all of these principles are likely to involve both types of preferences; these components, acting together, may manifest themselves in a principle of optimum heterogeneity. The prefigurements of visual art in our species can thus be understood a little better against its simian backgrounds. This should surprise no one who is even superficially acquainted with D'Arcy Thompson's classic book, *On Growth and Form* (1945), where this great zoologist, so far ahead of his time, dealt with the basis for beauty in numberless exquisite structures produced by the plant and animal worlds, and showed that it is possible to construct an abstract, purely geometrical theory of morphogenesis, independent of the substrate of forms and the nature of the forces that create them (Thorpe 1974: 302, Thom 1975: 8).

4. Architectural Signs

"A building is not only an object but also a sign", Bogatyrev (in Matejka and Titunik 1976: 18) noted in 1936, and Jakobson later elaborated on this dictum by stressing that "[a]ny edifice is simultaneously some sort of refuge and a certain kind of message" (1971: 703). The utility—i.e., technological interest—of different architectural configurations is thus generally taken for granted. What remains in question is their correlation with the corresponding universe of signifieds, in particular as regards its aesthetic dimension, and the direction of the artistic movement: is it from external form, considered as a signifier, toward internal organization, which becomes the signified, or is it the converse? The architectural work of art, everyone seems to agree, is devoted to the realization of several ends. It stands at the confluence of multiple interests. Its character is syncretic *par excellence.*

In looking at the endlessly manifold abodes constructed by animals—that serve perhaps to trap prey, to protect or comfort the architect or its kind, especially the young, or to attract the attention of a potential mate—we must look for the artistic value that may be involved, although subordinated to the principal interest of the "survival machine", as Dawkins (1978: 21, 25) calls the temporary receptacles housing the colony of genes inhabiting every plant and animal. If there is such a subsidiary purpose, falling passively under the sway of 'mere' biological advantage, or supplementing it, an effort must be made to ferret out this aesthetic component. Such a quest is far from trivial, for, in the end, it is tantamount to asking: what is art?

The sources for the materials utilized by animals to erect their dwellings are twofold: either the substances are produced from within their own body, or they are assembled from the environment surrounding them. In the latter case, members of some species may exhibit subtle preferences, which may justly be termed aesthetic, in their very selection of particular habitats. Indeed, Klopfer (1970: 400) even supposes that "the most convincing evidence for the existence of esthetic preferences come from the literature on habitat selection…". This discerning ethologist (1969: 57–58) has consistently allowed for constraints due to psychological factors, the most intriguing cases of which are posed by those situations in which the preferences cannot be related to physical abilities, "as when a particular color of flower or shape of leaf or complex of factors is preferred to any other"—as in Ripley's narrative (see Note 1, pp. 261–62). It is difficult enough to isolate the relevant feature of a complex *Gestalt;* to provide an explanation for the underlying sensory or neural basis for preferences that are termed aesthetic remains generally a difficult research problem for the future.

In the process of building, animals employ essentially the same techniques that we do: digging, masonry, plaiting, weaving, and so on. For Vitruvius—the failed Augustinian architect and engineer later turned influential writer—the universal *homo faber* was the architect, to whom the Romans assigned the art of building as well as the craft of fabricating machinery (i.e., secondary tools; see Sebeok 1972: 85). Vitruvius (1826: 3), in spelling out what architecture is, maintained that "two considerations must be constantly kept in view" in the execution of his art and craft, "namely, the intention, and the matter used to express that intention…". Whatever one's opinion may be about the intrusion of intention, volitional control, or, more broadly, of teleological considerations, into the domain of semiotics,[12] there can scarcely be any doubt that man fully shares the second attribute mentioned by Vitruvius with the speechless creatures.

In respect to the concept of *animal laborans*, the animal "which labors and 'mixes with'", or "which with its body … nourishes life", but which "still remains the servant of nature and the earth" (Arendt 1958: 136, 139), it is, in truth, hard to perceive essential differences among the species. Such discriminations as may exist must be sought in Arendt's redefined and refined view of the classic *homo faber*, an anthropocentrically utilitarian figure she nonetheless so insistently, although eloquently, opposed to *animal laborans*—*homo faber*, "who makes and literally 'works upon'", whose production is tantamount to

---

[12] I have previously alluded to these issues, and some of their implications, in Sebeok 1976: 35 (fn. 65), and 127, discriminating sharply between subjective and objective varieties of teleology. I was therefore surprised that several reviewers of my book, notably Martynov (1978: 178), took exception to my strictures, introducing, in the process, several levels of confusion into the argument. Martynov also regrets that I failed to cite the well-known book by Ackoff and Emery (1972), who devote their Chs. 10 and 11 to semiotics, but they simply rehearse notions already dealt with much better in various writings of Charles Morris. Matters of artistic intent are obviously pertinent to the subjects dealt with here, but space precludes the possibility of their detailed consideration. Concisely put, in my view, intention had best be regarded as a convention, and the intent of any sign simply its use.

what she calls reification, the creation, that is, of a uniquely human world in the face of nature. Only *homo faber*, she claims, “conducts himself as lord and master of the whole earth” (*ibid.* 139). For her (*ibid.* 173), *homo faber*, “in his highest capacity”, assumes, of course, the functions “of the artist, of poets and historiographers, of monument-builders or writers, because without them the only product of their activity, the story they enact and tell, would not survive at all”. This bleak and in the end still narrowly parochial view implies that none of the works of nature, which manifestly come into being without man’s intervention, let alone his midwifery, can have aesthetic or even economic value. As Karl Marx has put the same idea in *Das Kapital* (1933: 3: 698): “Der Wasserfall, wie die Erde überhaupt, wie alle Naturkraft hat keinen Wert, weil er keine in ihm vergegenständlichte Arbeit darstellt”. This attitude to nature and to natural productions degrades objects into means, where animals are always presumed to be building something not for its own sake but for the sake of instrumentality, or expediency toward the realization of some putative biological end. The absurdity of this Sophistic devaluation of nature was despised by many Greeks, as Arendt (1958: 157) noted, and its inherent anthropocentrism perhaps most persuasively resolved in Plato’s celebrated argument against Protagoras, whose subjective idealism fails to accord—as I have tried to show elsewhere (Sebeok 1978b—with the most elementary lessons of the modern life science.

The field of ‘natural architecture’ is exceptionally fortunate in that there exists a splendid recent book devoted to that subject in its entirety ranging from the invertebrates, particularly the arthropods, to the birds and on to the highest mammals, inclusive of apes. This compendium, which requires no specialized knowledge for its enjoyment, was written by Karl von Frisch (1974), in collaboration with his son, Otto. It bore the original title, *Tiere als Baumeister*—which translates into “Animals as Master Builders”—both more powerful and more suggestive, as well as less overburdened or presumptuous, than the English rendering on the title page.[13]

The architectural activity of animals is best regarded as a manifestation of tool-using behavior—a sophisticated way of manipulating objects and exploring their uses to adaptive advantage. According to Frisch (1974: 22), the use of tools that are not parts of their bodies is rare among animals: “They mostly use the organs of their bodies, chiefly their mouth parts and their legs”.[14]

---

13. Perhaps this obvious translation was avoided because it would have echoed the title of another book, *Master Builders of the Animal World*, published at about the same time (Hancocks 1973). The author of this book is an architect.

14. For a first approach to a semiotic typology of organismal vs. artifactual human and animal sign systems, see Sebeok 1976: 30–32. For further references to the use of

Rare though the use of extrinsic artifacts may be over-all, statistically speaking, newly discovered instances continue to be published. A case in point is a learned behavioral sequence recently detected in Northern blue jays (*Cyanocitta cristata*), which involves tool-making, to wit, by the tearing and alteration of pages from a newspaper, and employing these as tools to rake in food pellets which otherwise lay out of reach (Jones and Kamil 1973).

Even the larva of the green lacewing (*Chrysopa slossonae*) uses a tool in the climax of a complicated sequence that has been inelegantly dubbed "trash-carrying behavior" (Eisner *et al.* 1978). This insect form disguises itself as, i.e., mimics, its own prey by plucking some of the waxy "wool" from the bodies of the alder aphids amidst colonies of which it lives and feeds, and then applies this material to its own back. The exogenous shield thus constructed protects the larva from assault by the ants that ordinarily 'shepherd' the aphids.

Some social insects, notably, several species of *Aphaenogaster*—none of which are mentioned by Frisch, despite the relatively large amount of space (72–150) he otherwise devotes to the constructions of eusocial insects—use pieces of leaf, mud, and sand grains as tools for carrying soft foods from distant sources to the colony, a maximally efficient way of exploiting available resourses (Fellers and Fellers 1976).

I recite these random examples of recently uncovered cases of tool-using activity to adumbrate my hunch that such forms of behavior anticipate the more advanced forms of animals' building activities. In ethological jargon, the question becomes: how does tool-using behavior become ritualized (Sebeok 1979, Ch. 2)? Or, in semiotic parlance: how does a tool, with a primary amplifying function, acquire a superimposed sign-function (Sebeok 1976: 30)? The answer to this question, at this stage in the development of both ethology and diachronic semiotics, is precisely the same as to the deceptively innocent one, "What passes in the mind of a bowerbird when he builds and decorates his bower?" Frisch replies (1974: 244–45), "Naturally, I cannot answer [my own] question. No one can". His denial notwithstanding, Frisch proceeds to declare his conviction that in these birds, no less than in chimpanzees, "not only insight into the consequences of their actions but also evidence of aesthetic feelings can be found".

---

tools by birds, see Jones and Kamil 1973: 1078, n. 2. Guilmet (1977) is concerned with reconstructing the behavioral context which coevolved with tool-using and tool-making in the hominid lineage. He argues that the method of socialization practiced by a tool-making group would affect the degree of formal standardization presented by the tools themselves.

No purpose would be served by rehearsing here even a sampling from among the host of striking examples of exterior and interior designs masterfully adduced by Frisch. The multitalented bower-birds figure prominently, as does a large variety of other kinds of birds, including those consummate nestbuilders, the weavers, and especially *Malimbus cassini*, noted for the care and precision of the working male, reminiscent in his technique of a human basket weaver or one with a loom. Among the many mammals whose imposing labors are illustrated, the impressively productive accomplishments of the beaver (*Castor fiber*, or the American kind, *C. canadensis*), however, do deserve to be singled out. The fantastic edifices of this "architectural mute"—the evocative epithet was coined, in 1868, by Lewis H. Morgan (1970: 101)—are exemplified by the construction of dams, lodges, burrows, and canals. The opinion that "there is no other animal that can by its labor transform the landscape in the same way as can the beaver and man" (Wilsson 1969: 1) is shared by all informed observers. This pre-eminent master builder, particularly busy in the mountains, checks turbulent brooks and, with its dams, protects the fields and pastures below from becoming silted up with sand and gravel. The artificial reservoirs thus created are soon stocked with trout and other fishes, and turned into a refuge for water birds. The very magnitude of some beaver projects is stupefying—the largest dam is that on the Jefferson River, near Three Forks, Montana: one can follow it for some 2,300 feet. Although the beavers' basic engineering skills are innate—"the principles of their art are theirs by inheritance" (Frisch 1974: 278)—their brain is exceptionally well-developed in comparison with that of other rodents, and their correspondingly superior adaptability to changing ecological situations is emphasized by knowledgeable ethologists. Morgan (1970: 99) even felt "at liberty to infer an intention on the part of the beaver", and others believe that beavers profit from example or experience.

By contrast, there is nothing remarkable about the building activities of the Great Apes. Adult chimpanzees, in some regions, are known to fashion fresh nests up in the trees nightly, as do orangutans and gorillas, although heavy males among the latter tend to sleep on the group. Köhler's (1925, esp. Ch. V, on "Building") experiments with chimpanzees that solve the problem of getting fruit situated beyond the reach of their arms by manufacturing a suitable tool for bridging the distance from themselves to the food—by fitting two bamboo rods together, for instance, or by erecting a tower from packing cases—are widely known, although his interpretation is still debated. While the actions of Köhler's chimpanzees were portrayed as conveying an impression of deliberation and purpose, the animals seemed to have but a very modest sense of either statics (*ibid.* 161, 163–164) or balance. Some never managed to solve the problem at all.

The penumbra of an absorbing lifelong research commitment is delineated in two arresting sentences at the end of Frisch's study (1970: 286): "The evolutionary roots of human behavior reach far back into the behavior patterns of animals. Those who are fascinated by these connections need only fasten on one such puzzle, the architecture of animals perhaps…". The prefigurements of architecture, however, are but one detail in the mosaic of the much vaster, much deeper, mystery of the precultural emergence of the averbal arts.

5. Concluding Remarks

At the outset of this essay, I drew a sharp distinction between the verbal art and the averbal arts, proclaiming my conviction that, while it seems unavailing to search for the prefigurements of language-based sign systems, a scrutiny of the roots of the four other semiotic spheres discussed might prove illuminating. Differences in the neurological processing of verbal vs. averbal patterns of input and output are solidly and rationally grounded in separate dominions of the human brain. The evolutionary antecedents are also assuming shape, although they remain blurred at the edges.

The late Bronowski (1977: 112; cf. Sebeok 1976: 119) wondered whether "any animal language [has] figures of speech", by which he appeared to question whether an animal ever uses the same sign-vehicle corresponding to two or more different significates. The answer to the latter must unequivocally be in the affirmative, since the context in which any gesture is delivered decisively shapes its 'correct' interpretation. But Bronowski's 'figures of speech', as he used the expression in his exploratory article on "Human and Animal Language", is itself merely a figure of speech—a rhetorical device of his own. It has little to do with verbal art. To be sure, it has been widely reported that the creation of signed metaphors as well as metonyms was recorded in different home-raised chimpanzees. In 1976 (Sebeok 1979, Ch. 6), I recounted that both sorts of tropes were alleged to have occurred: "whereas Washoe created 'water-bird' for duck, a metonymic or indexical expression, being a sign in real reaction with the object noted …, Lucy generated 'candy fruit' for watermelon, a metaphoric or iconic term, possessing the qualities signified …". Lately, however, I—and others (e.g., Martin Gardner, personal communication)—have come to feel that such interpretations must be reviewed if not with suspicion at least with caution. Both chimpanzees were getting a steady stream of unconscious feedback from their trainers. Thus only her handler was present in the canoe when Washoe glimpsed her first duck and made a sign for 'water' followed by a sign for 'bird'. There was no awareness of the possibility that Washoe, dragging her hand in the water, didn't sign 'water', next noticed the bird, and only then signed 'bird'. The behavior of the trainer, who (for all we know) repeated the two signs, could easily have taught Washoe a new sign, namely, the 'water-bird' sign which she would associate from then on with ducks. The circumstances were, *mutatis mutandis*, similarly indeterminate for Lucy's 'candy fruit', 'cry fruit' (for onion), and for every other such case that I am aware of. All of these are subject to other, less portentous, construals, the simplest among which is the pervasive emission of subthreshold involuntary cuing of the destination by the source, or the 'Clever Hans' experience (Sebeok 1979, Chs. 4 and 5). In sum, there is no hard evidence whatsoever for the existence of figures of speech, in the literal sense, among the speechless creatures—a prototypal *contradictio in adiectivo*…!

A second leitmotif of my article skirted the profound problem of aesthetic significance—particularly in opposition to our juxtaposition with utility—viz., purposiveness or directedness, tantamount, in some contexts, to the Aristotelian art of *chrēmatisttikē*, or the amassment of wealth with no limit in respect of its end, but in this context simply to the preservation and improvement of the gene pool, or the long-term environment of the gene. The question whether animals are endowed with 'consciousness' has remained wide open (Griffin 1976), being no doubt poorly posed, but many distinguished life scientists concur that some animals on some occasions behave toward some objects *as if* the organisms were motivated by a recognizably aesthetic incentive. This much is clarion clear, for instance, as regards the bowerbirds.

The essence of the aesthetic impulse surely lies in the structures organisms extract and reconstruct from among salient features of their environment. Albrecht Dürer (Conway 1889: 182), among a host of commentators, believed this to be so; according to him, "Denn wahrhaftig steckt die Kunst in der Natur, wer sie heraus kann reissen, der hat sie". Others make a separation between natural or organic beauty, and artificial or aesthetic beauty, contrasting the realm of living things with that of 'living' forms. But the two are obviously bonded, since all the percipients themselves are a part of nature. The spectacles through which we see the world are partly an apparatus for bringing into focus certain aspects of our existence (*Umwelt*), but they are, at the same time, a means for relating harmoniously varied facets of the universe to each other. To paraphrase a saying of Henri Poincaré, aesthetic sensibility plays the part of a delicate sieve. The challenge, of course, is to explicitly define what those relations—of balance and order that delight—are in the characteristic idiom of each art, as well as in the all-embracing architectonics of the living megacosm. The concept of delight thus undergoes a radical transmutation: it is elevated into a function that biologists can recognize, objectify, cope with in familiar terms. The 'artistic animal' is not defined by a heightened sensitivity to movement, sound, color, shape, but by its innate and/or learned capacity to elicit a stable dynamic structure from the fluid environment, whether inorganic, organic, or a subtle blend of both. The sign systems thus created, which serve an underlying semantic function, take in time an aesthetic turn. How this happens is magesterially brought out in an 1865 Platonic dialogue on the origin of beauty that Gerard Manley Hopkins had composed for his tutor at Oxford (House and Storey 1959: 86–114).

The dialogue between the Professor of the newly founded chair of Aesthetics (no doubt Walter Pater) and a student takes place in the tranquil setting of a college garden, and the dialectic "battledore" quickly comes to concentrate on "one of the most finely foliaged of trees", the chestnut. The Professor points to the leaves of the tree to illustrate the principle of symmetry, or, more generally, of the structural relations inherent in nature. The Professor asks:

"…now what is symmetry? Is it not regularity?" "I should say, the greatest regularity …".

"So it is. But is it not that sort of regularity which is measured by length and breadth and thickness? Music for instance might be regular, but not symmetrical ever; is it not so?"

"Quite so …".

"Let us say regularity then".

The Professor next draws attention to the oak, "an unsymmetrical tree".

"Then beauty, you would say perhaps, is a mixture of regularity and irregularity".

"Complex beauty, yes. But let us inquire a little further. What is regularity? Is it not obedience to law? And what is law? Does it not mean that several things, or all the parts of one thing, are like each other"?

The Professor continues:

"…regularity is likeness or agreement or consistency, and irregularity is the opposite, that is difference or disagreement or change or variety".

But do these distinctions apply to all things? Beauty is certainly a relation, but *what* is this relation? The sense of beauty in fact is a comparison. The conversation now moves on to the subject of poetry: rhythm, meter, and rhyme.

"Now you remember I wished beauty to be considered as a regularity or likeness tempered by irregularity or difference: the chestnut-fan was one of my instances. In rhythm we have got the regularity, the likeness; so my aim is, as rhythm is agreed to be beautiful, to find the disagreement, the difference, in it … Rhythm therefore is likeness tempered with difference …".

"What is rhyme? … Is it not an agreement of sound—?"

"With a slight disagreement, yes. … In fact it seems to me rhyme is the epitome of [our] principle. All beauty may by a metaphor be called rhyme …".

If rhyme is taken as the poetic paradigm for beauty, consisting of comparison for likeness' sake (metaphor, simile) as well as for un-likeness' sake (antithesis, contrast), what is the convenient word which gives us the common principle for all such kinds of equations? Hopkins proffers *parallelism*, and moves on to analyze parallelism "both structural and unstructural", parallelism of expression and parallelism of sense, and finally to illustrate his dictum that "The structure of poetry is that of continuous parallelism" (*ibid.* 84).[15]

Now it is evident—to recapitulate briefly—that the conspicuous use of reiteration, of a statement of a theme with variations, of the creation of suspense and countervailing tension, of the arousal of expectation and its denial, in short, of parallelism, is also the pervasive pivotal device common to all manifestations of the art of animals discussed in this essay: what is criterial of their kinesthetic art is rhythmic somatic motion; at the heart of their music are "les rythmes organiques" and the transposition of fixed intervals; the cardinal substantives that characterize their picture making are "steadiness—symmetry—repetition—rhythm"; and the mark of their virtuoso architecture is surely geometrical symmetry—broken in multiform ways—that transmutes the ulterior modularity of physical reality into macroscopic projects of utility as well as beauty.

Hopkins' insight about the source of beauty was amplified by Humphrey a little over a century later (1973: 432). He asked: "What is the biological advantage of seeking out rhyming elements in the environment?" The answer he proposed was this: "considered as a biological phenomenon, aesthetic preferences stem from a predisposition among animals and men to seek out experiences through which they may *learn to classify* the objects in the world about them. Beautiful 'structures' in nature or in art are those which facilitate the task of classification by presenting evidence of the 'taxonomic' relations between things in a way which is informative and easy to grasp". This proposition demands a tripartite justification.

One must explain, to begin with, why the knack for classification should be important for biological survival. If the function of categorization is to sort out sensory experience—to identify, with essential economy, good, bad, and indifferent forms, or, in semiotic phrasing, to sift out the presence of such forms 'endowed with signification' that trigger appropriate long-term releasers—then the evolution of efficient classificatory techniques is bound to be of survival value. Humphrey (*ibid.* 433) argues that "just as with eating or with sex, an activity as vital as classification was bound to evolve to be a *source of pleasure*

---

[15] For an elaboration and application of Hopkins' pathbreaking studies to grammatical parallelism by a modern master, see Jakobson (1966).

to the animal. Both animals and men can, after all, be relied on to do best what they enjoy doing".[16]

Second, it is necessary to show why a maneuver such as Hopkins called parallelism should be optimally advantageous to the classificatory animal. It seems clear that the fundamental role of the central nervous system is precisely to provide the creature with a local map simulating its position in the environment, to enable it to sort out, among other vital intelligence, the images of biologically and/or socially important organisms, viz., to distinguish prey from predator. This is surely best accomplished by an arrangement of such images into a distinctive feature matrix, or in terms of "likeness tempered with difference". Parallelism is the organizing principle employed in many of the most successful taxonomical procedures, including the Linnaean (more generally, it imbues set-theory). "If it is helpful for the taxonomist to look for 'rhymes' in his materials", Humphrey continues, "so it is helpful for the animal to do so. It is for this reason that we have evolved to respond to the relation of beauty which rhyme empitomises. At one level we take pleasure in the abstract structure of rhyme as a model of well-presented evidence, and at another we delight in particular examples of rhyme as sources of new insight into how things are related and divided".

The third step is to seek evidence, beyond the prevailing propensity of man and animals to classify their surroundings, for the surmise that animals also are attracted in particular to parallelism. To amass a modicum of such testimony was, in fact, the main objective of this study: to adduce instances of parallelism in the animal world that have no demonstrable natural value but which nevertheless give people as well as the animals involved something akin to aesthetic pleasure, even when the process or the product is disunited from its proper biological context.

The universal propensity to classify dictates that animals generate units of signification, or significata, by stipulating redundancies. Several arrangements are possible, such as non-dimensional (taxonomic) classification or dimensional (paradigmatic) classification, in both of which classes are formed by means of intersection (Dunnell 1971: 44–45). When classes and sub-classes are created, they may be defined by features which are either inherent in nature as the sole feasible solution or, as in man and his tamed creatures, arrays that are arbitrary to a degree (cultural categories, individual idiosyncracies).

---

[16] In a recent article, Humphrey (1979: 47) argues that when exploratory behavior becomes an all-encompassing passion, it has exceeded its evolutionary function and turns into a perversion of sorts.

Yet even certain human populations may be “forced to meet nature on its own terms and to categorize those aspects of the natural environment which are relevant to it in a biologically realistic way” (Bulmer 1970: 1082). The conception of class, whether based upon naturally imposed or arbitrarily chosen qualities, sometimes acquires a certain elegance and power elevating it beyond a mere organizational tool, and we can then say that the production carries an aesthetic charge.

Lévi-Strauss and Piaget have both been concerned with primordial questions of human classification. The inquiry of Lévi-Strauss, instigated by a linguistic model, postulates a proclivity in all of us to think in opposites and contrasts, to pry perceptual information from the environment constrained by certain predetermined structures, and to consolidate and combine these percepts in classifying, naming, and mythic systems. Through a series of ordered transformations, these systems relate themes and variations upon them that are effable, for instance, in artistic products which themselves are embodiments of mind.

Animals create a taxonomy appropriate to their species and ecological niche. Thus predators, for instance, distinguish different categories of prey—by size, appearance, odor, and other signifiers—thus forstalling wastefully indiscriminate attacks. *Vice versa*, many potential prey distinguish among different kinds of predators, as we observe from then use of sundry warning signs, variations in their flight-distances and flight-reactions, e.g., depending on whether the enemy is up in the air or down on the ground. It is less well known, however, that animals assign to one another and carry proper names (Sebeok 1976: 138–40), which individuate each from every other. As Hediger (1976: 1357), who devoted a perceptive and semiotically sensitive study to the use of proper names in the animal kingdom, pointed out: “Its proper name is part of its [the animal’s] personality. Therefore it distinguishes between its own self and the non-self”.[17] Hediger also pleads for research on the appearance of proper names in evolution, for this may “open a new door to the delicate problem of selfconsciousness in animals”. Concern with naming, moreover, focuses attention on parallelism as a special case. Parallelism of this kind evokes a sort of pleasure familiar to all observers of children’s behavior. Humphrey (1973: 435–36) comments on this pronounced tendency in children, which is promoted, among other devices, through picture books designed especially for them. The passion for collecting, he feels, is yet another manifestation of the pleasure both mature children and men take in classification. Among the animals, it is not accident that bowerbirds are among the most sedulous of collectors, each species according to its predilection. Thus the display-ground of the Great Gray “may contain an almost

---

[17] On the notion of the ‘Semiotic Self, see Sebeok 1979, Appendix I.

inconceivable accumulation of pale or reflective rubbish"—but sometimes also bright specimens of gold or pieces of precious opal—yet every bit of their harvest of treasure "is chosen with great discrimination" (Marshall 1954: 92).

Piaget has demonstrated that young children are limited in performing internally consistent classificatory tasks. Shown an aggregate of diverse objects and asked to place together those that go together, the child will come up with a range of volatile groupings of phenomena that are not yoked by a simultaneous awareness of a whole and its parts, either physically or conceptually. A sense of hierarchy comes later, at a mature stage of operational intelligence; accordingly, sophisticated art usually emerges in human ontogeny as an accessory only to adult cognitive capacity. Comparisons of animal artistic productions with those by children were made as early as 1935, when Nadie Kohts juxtaposed drawings by her chimpanzee, Joni, with those by her son, Roody. She showed that early scribbles by Joni and early scribbles by Roody resembled each other greatly. However, while later drawings by Joni evidenced greater complexity but no imagery, those by Roody exhibited, in addition, mimetic qualities, to wit, the recognizable icon of a face (cf. Fig. 3 in Brothwell 1976: 21).

When Mukařovský delivered his seminal 1934 lecture, on "L'art comme fait sémiologique", he meant his study to underline and exemplify certain aspects of the dichotomy which he never questioned—between the natural sciences and the humanities, as well as to bring out the importance of semiotic considerations for aesthetics and for the history of art (Matejka and Titunik 1976: 8). Referring, in conclusion, to this programmatic paper, I should like to note the paradoxical aspect of the proposed enterprise: a consistently carried out characterization of every work of art as an autonomous sign composed of an artifact (the signifier), an aesthetic object (its signification), and an abstract, context-oriented relationship to the thing signified, tends precisely to obliterate the factitious schism it is supposed to uphold.[18]

References

Ackoff, Russell L., and Fred E. Emery
1972 *On Purposeful Systems.* Chicago: Aldine-Atherton. Alland, Alexander, Jr.

Ackoff, Russell L., and Fred E. Emery
1977 *The Artistic Animal: An Inquiry into the Biological Roots of Art.* Garden City: Anchor Press/Doubleday.

---

[18] Regrettably, Hediger's 1979 study on creativity in animals reached me only after my own essay had already been typeset.

Andrews, Michael
1976 *The Life that Lives on Man.* New York: Taplinger.
Appun, Karl
1871 *Unter den Tropen.* Jena: H. Costenoble.
Arendt, Hannah
1958 *The Human Condition.* Chicago: University of Chicago Press.
Armstrong, Edward A.
1963 *A Study of Bird Song.* London: Oxford University Press.
Armstrong, Edward A.
1965 *Bird Display and Behaviour: An Introduction to the Study of Bird Psychology.* New York: Dover.
Arnheim, Rudolf
1954 *Art and Visual Experience.* Berkeley: University of California Press.
Autrum, Hansjochem
1972 “The Communications Network of the Human Body”. In: Heinz Friedrich (ed.), *Man and Animal: Studies in Behaviour*, 77–81. London: MacGibbon & Kee.
Barthes, Roland
1957 *Mythologies.* Paris: Seuil.
Bascom, William R.
1955 “Verbal Art”, *Journal of American Folklore* 68, 245–52.
Bateson, Gregory
1968 “Redundancy and Coding”. In: Thomas A. Sebeok (ed.), *Animal Communication: Techniques of Study and Results of Research*, 614–26. Bloomington: Indiana University Press.
Bauman, Richard
1977 *Verbal Art as Performance.* Rowley: Newbury House.
Blanford, William T.
1889–91 *The Fauna of British India: Mammalia.* London: Taylor and Francis.
Boas, Franz
1955 [1927] *Primitive Art.* New York: Dover.
Bouissac, Paul
1976 *Circus and Culture: A Semiotic Approach.* Bloomington: Indiana University Press.
Bourne, Geoffrey H.
1971 *The Ape People.* New York: G. P. Putnam’s Sons.
Bronowski, Jacob
1977 *A Sense of the Future: Essays in Natural Philosophy.* Cambridge: MIT Press.
Brothwell, Don R. (ed.)
1976 *Beyond Aesthetics: Investigations into the Nature of Visual Art.* London: Thames and Hudson.

Bulmer, Ralph

1970 “Which Came First, the Chicken or the Egg-Head?”. In: Jean Pouillon and Pierre Maranda (eds.), *Échanges et Communications* 2, 1069–91. The Hague: Mouton.

Cherry, Colin

1978 *On Human Communication: A Review, a Survey, and a Criticism.* Cambridge: MIT Press.

Conway, William M.

1889 *Literary Remains of Albrecht Dürer.* New York: Cambridge University Press.

Darwin, Charles

1901 [1874] *The Descent of Man.* London: John Murray.

Davis, Roger T.

1974 *Monkeys as Perceivers.* New York: Academic Press.

Dawkins, Richard

1978 *The Selfish Gene.* New York: Oxford University Press.

Dobzhansky, Theodosius

1962 *Mankind Evolving: The Evolution of the Human Species.* New Haven: Yale University Press.

Dücker, Gerti

1963 “Spontane Bevorzugung arteignener Farben bei Vögeln”, *Zeitschrift für Tierpsychologie* 20, 43–65.

Dunnell, Robert C.

1971 *Systematics in Prehistory.* New York: The Free Press.

Eibl-Eibesfeldt, Irenaus

1975 *Ethology: The Biology of Behavior.* New York: Holt, Rinehart and Winston.

Eisenberg, John F., and Wilton S. Dillon

1971 *Man and Beast: Comparative Social Behavior.* Washington: Smithsonian Institution Press.

Eisner, Thomas, Karen Hicks, Maria Eisner, and Douglas S. Robson

1978 “ ‘Wolf-in-Sheep’s-Clothing’ Strategy of a Predatious Insect Larva”, *Science* 199, 790–94.

Fellers, Joan H., and Gary M. Fellers

1976 “Tool Use in a Social Insect and Its Implications for Competitive Interactions”, *Science* 192, 70–72.

Ferguson, Eugene S.

1977 “The Mind’s Eye: Nonverbal Thought in Technology”, *Science* 197, 827–36.

Frings, Hubert, and Mabel Frings

1977 *Animal Communication.* Norman: University of Oklahoma Press.

Frisch, Karl von

1954 *The Dancing Bees.* London: Methuen.

Frisch, Karl von
1967 *The Dance Language and Orientation of Bees.* Cambridge: Harvard University Press.

Frisch, Karl von
1974 *Animal Architecture.* New York: Harcourt Brace Jovanovich.

Gannon, Gilbert R.
1930 "Observations on the Satin Bower Bird with Regard to the Material Used by It in Painting Its Bower", *Emu* 30, 39–41.

Greene, Charles W.
1924 "Physiological Reactions and Structure of the Vocal Apparatus of the California Singing Fish", *American Journal of Physiology* 70, 496–99.

Greenewalt, Crawford H.
1968 *Bird Song: Acoustics and Physiology.* Washington: Smithsonian Institution Press.

Griffin, Donald R.
1976 *The Question of Animal Awareness: Evolutionary Continuity of Mental Experience.* New York: Rockefeller University Press.

Guilmet, George M.
1977 "The Evolution of Tool-Using and Tool-Making Behaviour", *Man* 12, 33–47.

Guthrie, R. Dale
1976 *Body Hot Spots: The Anatomy of Human Social Organs and Behavior.* New York: Van Nostrand Rheinhold.

Hachet-Souplet, Pierre
1897 *Le dressage des animaux et les combats de bêtes, révélation des procédés employés par les professionels pour dresser le chien, le singe, le cheval, léléphant, les bêtes féroces, etc.* Paris: Firmin Didot.

Haldane, J. B. S.
1956 "The Argument from Animals to Men: An Examination of Its Validity for Anthropology", *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 86/II, 1–14.

Hall-Craggs, Joan
1969 "The Aesthetic Content of Bird Song". In: Robert A. Hinde (ed.), *Bird Vocalizations: Their Relations to Current Problems in Biology and Psychology*, 367–81. Cambridge: Cambridge University Press.

Hancocks, David M.
1973 *Master Builders of the Animal World.* New York: Harper & Row.

Hanna, Judith L.
1977 "To Dance Is Human: Some Psychobiological Bases of an Expressive Form". In: John Blacking (ed.), *The Anthropology of the Body*, 211–32. London: Academic Press.

Hartshorne, Charles
1973 *Born to Sing: An Interpretation and World Survey of Bird Song.* Bloomington: Indiana University Press.

Hediger, Heini
1976 "Proper Names in the Animal Kingdom", *Experientia* 32, 1357–64.

Hediger, Heini
1979 "Kreativität beim Tier". In: Maja Svilar (ed.), *Seele und Leib—Geist und Materie*, 193–216. Bern: Peter Lang.

Henle, Paul (ed.)
1958 *Language, Thought, & Culture.* Ann Arbor: University of Michigan Press.

House, Humphry, and Graham Storey
1959 *The Journals and Papers of Gerard Manley Hopkins.* London: Oxford University Press.

Humphrey, Nicholas K.
1971 "Colour and Brightness Preferences in Monkeys", *Nature* 229, 615–17.

Humphrey, Nicholas K.
1972 "Interest and Pleasure: Two Determinants of a Monkey's Visual Preference", *Perception* 1, 395–416.

Humphrey, Nicholas K.
1973 "The Illusion of Beauty", *Perception* 2, 429–39.

Humphrey, Nicholas K.
1979 "The Biological Basis of Collecting", *Human Nature* 2, 44–47.

Jakobson, Roman
1966 "Grammatical Parallelism and Its Russian Facet", *Language* 42, 399–429.

Jakobson, Roman
1971 *Selected Writings, II: Word and Language.* The Hague: Mouton.

Jenkins, Iredell
1958 *Art and the Human Enterprise.* Cambridge: Harvard University Press.

Jones, Thony B., and Alan C. Kamil
1973 "Tool-Making and Tool-Using in the Northern Blue Jay", *Science* 180, 1076–78.

Klopfer, Peter H.
1969 *Habitats and Territories: A Study of the Use of Space by Animals.* New York: Basic Books.

Klopfer, Peter H.
1970 "Sensory Physiology and Esthetics", *American Scientist* 58, 399–403.

Köhler, Wolfgang
1922 "Zur Psychologie des Schimpansen", *Psychologische Forschung* 1, 2–46.

Köhler, Wolfgang
1925 *The Mentality of Apes.* London: Routledge & Kegan Paul.
Lawick-Goodall, Jane van
1967 *My Friends the Wild Chimpanzees.* Washington: National Geographic Society.
Lawick-Goodall, Jane van
1968 *The Behaviour of Free-Living Chimpanzees in the Gombe Stream Reserve.* Animal Behaviour Monographs 1/3, 161–311.
Lawick-Goodall, Jane van
1971 *In the Shadow of Man.* Boston: Houghton Mifflin.
Lévi-Strauss, Claude
1964 *Le cru et le cuit.* Paris: Plon.
Lotman, Jury M.
1967 "Tezisy k probleme 'Iskusstvo v rjadu modelirujuščix sistem' ", *Trudy po znakovym sistemam* 3, 130–45.
Maclaren, Jack
1926 *My Crowded Solitude.* New York: R. M. McBride & Co.
McNeill, David
1973 "Sentence Structure in Chimpanzee Communication". In: Kevin Connolly and Jerome Bruner (eds.), *The Growth of Competence*, 75–94. New York: Academic Press.
Marler, Peter, and Andrew Gordon
1968 "The Social Environment of Infant Macaques". In: David C. Glass (ed.), *Biology and Behavior: Environmental Influences*, 113–29. New York: Rockefeller University Press.
Marshack, Alexander
1972 *The Roots of Civilization: The Cognitive Beginnings of Man's First Art, Symbol and Notation.* New York: McGraw-Hill.
Marshall, Alexander J.
1954 *Bower-Birds: Their Displays and Breeding Cycles.* Oxford: Clarendon Press.
Martynov, V. V.
1978 "Review of Sebeok 1976", *Literatury i jazyka* 37/2, 178–79.
Marx, Karl
1933 *Das Kapital. Marx-Engels Gesamtausgabe*, Part II. Zürich: Ring-Verlag.
Matejka, Ladislav, and Irwin R. Titunik (eds.)
1976 *Semiotics of Art: Prague School Contributions.* Cambridge: MIT Press.
Merriam, Alan P.
1964 *The Anthropology of Music.* Evanston: Northwestern University Press.

Morgan, Lewis H.
1970 [1868] *The American Beaver and His Works.* New York: Burt Franklin.

Morris, Desmond
1962 *The Biology of Art: A Study of the Picture-Making Behaviour of the Great Apes and Its Relationship to Human Art.* New York: Alfred A. Knopf.

Moynihan, Martin
1966 "Communication in the Titi Monkey, Callicebus", *Journal of Zoology* 150, 77–127.

Mukařovský, Jan
1976 [1936] "Art as Semiotic Fact". In: Matejka and Titunik (eds.), 3–9.

Nelson, Keith
1973 "Does the Holistic Study of Behavior Have a Future?" In: Paul P. G. Bateson and Peter H. Klopfer (eds.), *Perspectives in Ethology*, New York: Plenum.

Nissen, Henry W.
1932 "A Field Study of the Chimpanzee: Observations of Chimpanzee Behavior and Environment in Western French Guinea", *Comparative Psychology Monographs* 8:36, 1–222.

Nottebohm, Fernando
1972 "The Origins of Vocal Learning", *The American Naturalist* 106, 116–40.

Nottebohm, Fernando, Tegner M. Stokes, and Christina M. Leonard
1976 "Central Control of Song in the Canary, *Serinus Canarius*", *Journal of Comparative Neurology* 165, 457–86.

Panofsky, Erwin
1955 *Meaning in the Visual Arts: Papers In and On Art History.* Garden City: Doubleday.

Payne, Roger S., and Scott McVay
1971 "Songs of the Humpback Whales", *Science* 173, 587–97.

Pfeiffer, John E.
1969 *The Emergence of Man.* New York: Harper & Row.

Popper, Karl R., and John C. Eccles
1977 *The Self and Its Brain.* Berlin: Springer.

Reinert, Jürgen
1965 "Takt- und Rhythmusunterscheidung bei Dohlen", *Zeitschrift für Tierpsychologie* 22, 223–71.

Rensch, Bernhard
1958 "Die Wirksamkeit ästhetischer Faktoren bei Wirbeltieren", *Zeitschrift für Tierpsychologie* 15, 447–61.

Rensch, Bernhard
1961 "Malversuche mit Affen", *Zeitschrift für Tierpsychologie* 18, 347–64.

Rensch, Bernhard
1972 *Homo Sapiens from Man to Demigod.* New York: Columbia University Press.

Rensch, Bernhard
1976 "Basic Aesthetic Principles in Man and Animals". In: Günter Altner (ed.), *The Nature of Human Behaviour*, 322–45, 445–47. London: Allen & Unwin.

Romanes, George John
1892 *Darwin, and After Darwin: An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions.* Chicago: Open Court.

Royce, Anya Peterson
1977 *The Anthropology of Dance.* Bloomington: Indiana University Press.

Sachs, Curt
1937 *World History of the Dance.* New York: Norton.

Schiller, Paul
1951 "Figural Preferences in the Drawings of a Chimpanzee", *Journal of Comparative Physiological Psychology* 44, 101–11.

Sebeok, Thomas A.
1972 *Perspectives in Zoosemiotics.* The Hague: Mouton.

Sebeok, Thomas A.
1976 *Contributions to the Doctrine of Signs.* Lisse: Peter de Ridder Press.

Sebeok, Thomas A.
1978a "Talking with the Body", *Times Literary Supplement* 3, 957 (January 27), p. 84.

Sebeok, Thomas A.
1978b *Considerazioni sulla semiosi.* Urbino: Centre Internazionale di Semiotica e di Linguistica 77/A.

Sebeok, Thomas A.
1979 *The Sign & Its Masters.* Austin: University of Texas Press.

Sebeok, Thomas A., ed.
1977 *How Animals Communicate.* Bloomington: Indiana University Press.

Shepherd, William T.
1915 "Some Observations on the Intelligence of the Chimpanzee", *Journal of Animal Behavior* 5, 391–96.

Simpson, George Gaylord
1966 "The Biological Nature of Man", *Science* 152, 472–78.

Slud, Paul
1957 "The Song and Dance of the Long-Tailed Manakin, *Chiroxiphia Linearis*", *The Auk: A Quarterly Journal of Ornithology* 74, 333–39.

Smith, W. John
1977 *The Behavior of Communicating: An Ethological Approach.* Cambridge: Harvard University Press.

Spencer, Herbert
1897 *The Principles of Psychology.* New York: D. Appleton.
Stonor, Charles R.
1940 *Courtship and Display among Birds.* London: Country Life.
Szöke, Peter
1963 "Ornitomuzikológia", *Magyar Tudomány* 9, 592–607.
Tax, Sol, and Charles Callender (eds.)
1960 *Issues in Evolution.* Chicago: University of Chicago Press.
Thom, René
1975 *Structural Stability and Morphogenesis: An Outline of a General Theory of Models.* Reading: W. A. Benjamin.
Thompson, D'Arcy Wentworth
1945 *On Growth and Form.* Cambridge: Cambridge University Press.
Thorpe, William H.
1972 *Duetting and Antiphonal Song in Birds: Its Extent and Significance* (*Behaviour*, Monograph Supplement 18). Leiden: Brill.
Thorpe, William H.
1974 *Animal Nature and Human Nature.* Garden City: Anchor Press/ Doubleday.
Tigges, Margarete
1963 "Muster- und Farbbevorzugung bei Fischen und Vögeln", *Zeitschrift für Tierpsychologie* 20, 129–42.
Uexküll, Thure von,
Forthcoming Positionspapier über das Thema "Semiotik der Angst".
Vitruvius Pollio, Marcus
1826 *The Architecture of Marcus Vitruvius Pollio, in Ten Books*, trans, by Joseph Gwilt. London: Priestly and Weale.
Vygotsky, Lev Semenovich
1971 *The Psychology of Art.* Cambridge: MIT Press.
Waddington, Conrad H.
1969 *Behind Appearance: A Study of the Relations between Painting and the Natural Sciences in this Century.* Edinburgh: Edinburgh University Press.
Washburn, Sherwood L.
1978 "Human Behavior and the Behavior of Other Animals", *American Psychologist* 33, 405–18.
Wescott, Roger W. (ed.)
1974 *Language Origins.* Silver Spring: Linstok.
Wilsson, Lars
1969 *My Beaver Colony.* London: Souvenir.
Young, John Z.
1971 *An Introduction to the Study of Man.* Oxford: Clarendon.

Theoretical and Metatheoretical Perspectives

Introduction

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

In this section, we have gathered some theoretical texts that expand the limits of thinking about animal semiosis and communication and question some conventional understandings. Since biological science puts greater value on empirical research and practical results, theoretical and speculative approaches to animal communication are not very common. Theoretical works on animal communication are often placed under the labels of history or philosophy of science, perhaps also semiotics, which has frequently been considered a theoretical discipline in itself, studying sign systems that humans use to articulate and communicate knowledge.

The theoretical perspective is first about articulating the basis of our knowledge. Emphasis can be put on epistemology, asking questions like what can we know about animals and how do we know it? We could also focus on concepts and terminology used to describe animal communication, and ask whether we use our language uncritically, whether our concepts are value-loaded, perhaps even anthropomorphic, and how this may influence our thinking. We can scrutinize the foundations of our empirical research, asking questions about the assumptions and the ad hoc components of our study, or searching for the blind spots of the theory. We can also question the position of the researcher: what are his/her relations to the research objects, is s/he influenced by some social value system and how this is expressed in the research?

The four texts we have selected for this section are of different types and point to different theoretical issues. At the same time they also have overlaps, from where tensions and dialogues can arise. Peter Marler's article "The logical analysis of animal communication" is a lucid introduction to the theoretical aspects of the study of animal communication and aims to blend semiotic and ethological perspectives. W. John Smith's text "Animal communication and the study of cognition" is a polemical and rather sophisticated synthesis of his long preoccupation with animal communication. The other two texts are by Gregory Bateson. "Problems in Cetacean and other mammalian communication" is a conference presentation on the methodological basis for studying communication in whales and dolphins. "What is instinct", on the other hand, is a rather unusual text that belongs to the genre of metalogues created by Bateson himself. Metalogues are conversational texts designed to discuss controversial subjects and highlight paradoxes in human thinking and language.

Peter Marler is an outstanding researcher of animal communication systems who has studied bird song, monkey and ape communication, alarm calls and many other topics. Peter Marler has contributed to the books edited by Thomas A. Sebeok and he has introduced semiotic theories and terminology into biological sciences as well as advocated the role of semantic meaning in animal communication systems (e.g. Marler 1998). Also the early text included in this Reader combines semiotic and ethological viewpoints and for this purpose introduces special semiotic terminology created by the American semiotician Charles Morris. Morris's approach to semiotics is rather objectivistic and thus suits such synthesis well. We note here the inherent significance of Charles Morris for zoosemiotic studies: he has developed an explicitly zoosemiotic interpretation of Peircean semiotics and has often used animal behaviour and communication to illustrate his theoretical models. Nowadays his works are largely discarded from mainstream semiotics because of their behaviouristic flavour, but their reinterpretation from the contemporary zoosemiotic perspective is a task still waiting to be carried out.

Peter Marler makes use of Morris's distinction between identifiers (a sign that signifies a location in space and time), designators (signifying characteristics of the objects or environment), appraisors (signifying the preferential status or situation) and prescriptors (signifying the specific responses that are required) (Morris 1971: 142, *see p. 257, below*), and shows how these can be used for describing a specific animal communication system, for instance the song of the chaffinch. He considers designative information to be primary and discusses under this species-specific signals and sexual, individual, motivational and environmental information. Whereas in human communication environmental information (referring to something separate from the sender as well as the receiver) has the primary role, other animals communicate a lot about sexual, individual and motivational information, that is, basically about themselves. Marler discusses, also, several zoosemiotically important principles of animal communication, such as the Darwinian principle of antithesis where opposite meanings are expressed by opposite gestures, continuity vs. discreteness in signals, divisibility, where one signal can have several informational contents, the relationship between signal form and content and many others.

In his text Marler makes several references to Hockett's list of design features of human language and also the titles of the two papers are quite similar. As references to this well-known article appear also in other texts of this Reader, we shall briefly comment on Hockett's (1960) study here. Hockett's article was an attempt to bring a more methodical and logical approach into discussions on human language. He distinguished originally thirteen characteristics of human language and observed how these are expressed in other species. These design features of human language are: 1) use of vocal auditory channel; 2) broadcast transmission and directional reception; 3) rapid fading; 4) interchangeability; 5) total feedback; 6) specialisation; 7) semanticity; 8) arbitrariness; 9) discreteness; 10) displacement, 11) productivity; 12) duality; 13) cultural or traditional transmission. Some of those features (1, 2, 3, 6, etc.) are common to many animal communication systems and others are rather a matter of degree, than of type. More specific to human spoken language are supposedly displacement (ability to refer to objects in another time or place), productivity (openness to new messages) and duality (ability to derive large number of meaningful units from a small number of structural units). However, we should remember that the starting point for Hockett's list was human language; if the starting point would have been the 'dance language' of bees, the design features would have been quite different.

In his article, Marler points out that messages in animal communication may often have several meanings or functions that are hard to separate. This is especially true of designative (about objects and environment) and prescriptive information (how should one act) that are often combined in the same message. From here it is convenient to proceed with the text by W. John Smith who debates with Marler and argues that the great majority of animal signals are not actually designative but rather carry information about the signaller's behavioural patterns. In his own words: "Each formalized signal has multiple referents: (a) several kinds of behavior (plus their probabilities and other variables), (b) physical characteristics of the signaller (e.g., its species and other identities), and (c) for some signals, external stimuli to which the signaller is responding" (*see p. 284, below*). W. John Smith is an original thinker in animal communication studies with a strong theoretical background. He is perhaps best known for his strong emphasis on the role of context and contextual information in animal communication. He has argued that "the 'meaning' of a signal to a recipient should be considered with the reference to context, since, for the recipient, context is unavoidable" and "message plus context should yield a much more detailed meaning" (Smith 1965: 406, 407). Context, according to his view, can be divided between immediate context (of other sensory inputs) and historical context (selection of inputs both because of memory and natural selection).

In the paper presented in this reader W. John Smith argues against the ordinary understanding of communication: "Preconceived categories of behavior must be questioned continuously and modified or replaced as necessary, and a considerable range of events must be studied" (*see p. 283, below*). Emphasizing the role of the message and its referential relationship to objects may also be a sort of anthropocentrism, as signs detachable from their context of use are the foremost characteristics of human language. To support his view that communication is mostly about the sender's probable behaviours, Smith discusses the effect an audience has on communication, historical sources of information that receivers can use to make predictions about the sender's behaviour, and the receivers' abilities to perceive, select and synthesise many different types of information. Although the editors of this Reader are not fully persuaded by the idea that animals use received messages for generating future predictions and choose among competing predictions (*see p. 293, below*), we note the closeness of W. John Smith's views to the semiotic approach. This is especially so because of the amount of freedom it gives to the receiver to select and interpret the message. This goes contrary (also quite literally, see Smith 1986) to many approaches of general communication theory as well as Neo-Darwinian evolutionary biology where signals are seen as the sender's means to manipulate the behaviour of the receiver.

Gregory Bateson was an anthropologist, psychiatrist, cyberneticist, semiotician and probably one of the most extraordinary thinkers of the 20th century. Questions of animal semiosis and communication were without doubt of great interest for him, although he did not write many articles explicitly dedicated to this field. One of those few texts is "Problems in Cetacean and other mammalian communication". Bateson's starting point is relatively similar to that of Smith. Rather than assuming that communication systems of other animals are similar to ours, it is more appropriate to speculate that communication systems of other animals may have been built onto very different preconditions and biological foundations. Assumptions that other animal sign systems operate similarly to those of humans and that, for instance, mechanisms for cracking codes of human language can be used to decipher the codes in other animal communication could simply be false. Where Smith argues, that communication is very much about predicting the sender's behaviour, Bateson suggests that communication, at least in mammals, is mostly about relationships. In the latter's words: "what was extraordinary—the great new thing—in the evolution of human language was not the discovery of abstraction or generalization, but the discovery of how to be specific about something other than relationship" (*see p. 305, below*).

Bateson gives examples: how dependencies, hierarchies and other relationships are communicated among mammals especially of cats and wolves. It seems that in such communication kinaesthetic signs, gestures and spatial relations have special importance. Even humans often draw information in communicative situations not on the basis of the message's informational content but on the basis of the tone of voice, facial expressions and other similar nonverbal information. Here we can also recall Sebeok's key distinction between zoosemiotic and verbal modelling systems (e.g. verbal and nonverbal art). What seems to be specific to marine mammals because of their watery environment is the lack of kinaesthetic signs that other mammals use to communicate relationships. Thus the interesting question arises: do Cetaceans use the vocal channel to communicate relationships and what influence would this have on their vocalizations? In the final part of his text, Bateson sketches a possible methodology for studying communication in Cetaceans.

As often in Bateson's writings we find also in this text a kind of layered view on processes: learning is accompanied by deutero-learning (learning the context or rules for learning), and also communication is described as a two-layered process. According to Bateson messages in communication are meaningful first in the sense that they affect the behaviour of the recipient animal and, secondly, in the sense that the success or failure of a communicative situation affects the relationship between two animals (*see p. 304, below*). If the communication of mammals is mostly about relationships, such duality may become especially significant. If an animal has sufficient cognitive capacity, it may also make a choice based on some higher layer of the system—for instance, in laboratory experiments an animal "may or may not choose to do 'right', even after he knows which is right" (*see p. 306, below*).

Bateson's metalogues are a specific genre of texts that use contradictions, circular argumentation, metaphors, contingencies and other similar means to expose particular topics. Thus metalogues are more similar to poetry or prose than academic writing, and are therefore difficult to assess adequately. Metalogue "What is an instinct" does not answer the posed question directly, but rather contemplates the ways how we think and talk about animal behaviour and communication. Its primary focus is on epistemology. Bateson emphasizes the conventional nature of our thinking: "instinct" is not something solid and existing, but rather an "explanatory principle" used to denote a group of phenomena that is for the given theory too complex and complicated to be explained any further. However, quite often such theoretical concepts (e.g. gene, Gaia), tend to acquire a life of their own and begin to influence academic discourse. They are approached as if they were real objects and not semiotic constructs.

In another line of thinking, Bateson questions human objectivity and its influence on our understanding of other animals. It is quite self-evident that 'objectivity' is something related to the language capacity; only with the help of language (especially written language) can knowledge become separated from the knower and the specific situation. An ability to assume an 'objective' position is something entirely human. Talking about an ‘objective’ mole or gull (a non-human animal with objectivity) would be strange and contradictory. According to Bateson, animal behaviour and communication are rather subjective and perhaps similar to what we experience in dreams, poetry or metaphoric language. Using an objective approach to describe such phenomena would create an odd situation, a kind of inevitable anthropomorphism, where we distinguish things beyond necessity, and use highly sophisticated schemas for depicting animal communication. Would this bring us any closer to understanding animal communication? Bateson notes that from the wide variety of possible phenomena, it is especially those that are selected for studies of animal communication that match the criterion of objectivity. Different epistemological foundations would lead us to different questions and probably also to a different type of answers. Bateson, however, does not give many suggestions or answers in his text; instead he exposes problems, raises issues and leaves further perspectives open.

References

Hockett, Charles F.
1960 Logical considerations in the study of animal communication. In: Wesley E. Lanyon and William N. Tavolga (eds.), *Animal Sounds and Communication*, 392–430. Washington: American Institute of Biological Sciences.

Marler, Peter
1998 Animal communication and human language. In: N. G. Jablonski and L. C. Aiello (eds.), *The Origin and Diversification of Language*, 1–19. California: California Academy of Sciences.

Morris, Charles
1971 Signs, language, and behavior. In: *Writings on the General Theory of Signs*. (Approaches to Semiotics 16), 73–397. The Hague: Mouton.

Smith, W. John
1965 Message, meaning, and context in ethology. *American Naturalist* 99(908), 405–409.

Smith, W. John
1986 An “informational” perspective on manipulation. In: Robert W. Mitchell, Nicholas S. Thompson (eds.), *Deception. Perspectives on Human and Nonhuman Deceit*, 71–86. New York: State University of New York Press.

The Logical Analysis of Animal Communication*

Peter Marler

Introduction

By any reasonable definition of the term "communication" there can be no doubt that animals communicate with each other. Some authors even extend the term to include exchange of stimuli between organisms and their physical environment (Stevens, 1950), which is perhaps further than it is necessary to go. The position adopted in a recent book by C. Cherry (1957) serves very well to restrict the discussion to a social context. He defines communication as: "The establishment of a social unit from individuals by the use of language or signs". Inclusion of both signs and language in this definition ensures from the outset that studies of communication systems shall not be restricted to the languages of man. This simple step, which so many past authors have been reluctant to take leads Cherry into a lucid, illuminating account of the properties of communication systems and of the methodological problems which they pose. As a student of animal behavior who has been grappling with problems of animal communication the writer has been struck by the relevance to zoology of many of the ideas expressed in Cherry's book. This paper tries to apply some of them to animal communication and to show that they can open up new avenues to the understanding of the kind of evolutionary problems with which many zoologists are concerned.

The Anthropocentric Approach

Comparative psychologists have neglected the subject of animal communication to a remarkable degree—remarkable, that is, until one reflects on the anthropocentric point of view of most psychologists. The strictures imposed by F. A. Beach (1959) on comparative psychology are nowhere more relevant than in the subject of animal communication. The main concern has been to differ-

---

* From: Marler, Peter 1961. The logical analysis of animal communication. *Journal of Theoretical Biology* 1, 295–317. Reproduced with permission of Elsevier.

entiate man and the animals, rather than to determine the properties which their "languages" may have in common. Dozens of cases could be cited where this prejudice has influenced the questions that are asked, and therefore the answers obtained. Even in such distinguished contributions as the chapter on the social significance of animal studies by D. O. Hebb & W. R. Thompson (1954) in the "Handbook of Social Psychology" this bias is evident. After discussing the human capacity to combine and readily recombine sounds for different effects, they acknowledge that language has other distinctive characteristics but assert their belief that the above criteria "are enough to set it off fully from animal communication". A promising discussion thus terminates at the point where it is about to become productive. In the field of linguistics attempts to analyse animal communication have also been marred by anthropocentric viewpoints (e.g. Revesz, 1956), although it is also a linguist, C. F. Hockett (1961), who has succeeded in defining the properties of human language in a manner that permits us to test for their occurrence in animals. In doing so, he has omitted "purposiveness" as one of the criteria. This concept, which may also be associated with an anthropocentric viewpoint, has bedevilled investigations of animal behavior in the past (Thorpe, 1956).

Purposiveness

Hebb and Thompson (1954) question whether the waggle dance of the honey bee (von Frisch, 1954) is purposive, suggesting that it would be if:

(*a*) only the first of several returning bees made the waggle, since, if the message has already been conveyed to the colony by ten other bees, there is little sign of purpose in behavior that conveys it once more; and

(*b*) the worker still made the dance as though the audience was present even when it had been removed.

(*a*) seems to be based on the misconception that the entire contingent of perhaps ten thousand workers can perceive the performances of a dozen or so dancers. The solution to (*b*) is not certain, but personal observations suggest that an eager audience in the hive is certainly stimulating to a dancer. However, we may ask whether this is a sign of purposiveness, or whether the dancer is simply stimulated through palpation by the antennae of the audience.

If the concept of purposiveness has to be reduced to such a vague level before it can be tested, as Hebb and Thompson seem to imply, we may wonder whether it has not ceased to be valuable as a theoretical construct in the analysis of animal behavior. W. H. Thorpe (1956) has pointed out how difficult the subjective and objective aspects of purposiveness are to separate. It may be best to restrict the idea of purposiveness to a human context. Hebb & Thompson (1954) state that the essence of purposive communication is that "the sender remains sensitive to the receiver's responsiveness during sending, and by modification of his sending shows that his behavior is in fact guided by the intention of achieving a particular behavioral effect in the receiver". By this definition any dog-fight qualifies as purposive, as the authors admit. It is not clear what is gained by using a specialized and loaded term for a process which is basically a mutual communicatory exchange, unless to draw attention to possible subjective phenomena. If the latter, then we should recall Thorndike's (1911) still relevant warning about the dangers of the introspective method in animal studies, notwithstanding Tolman's (1932) demonstration that by placing special interpretations upon it, purposiveness can be given an objective basis.

An Objective Approach

The descriptive or taxonomic approach, which comes less readily to psychologists than to zoologists, has provided the bulk of our present knowledge about animal communication, as applied by such classic investigators as Charles Darwin and K. von Frisch. This in turn has led to new inductive generalizations by K. Z. Lorenz, N. Tinbergen, W. H. Thorpe and others which will provide the framework of future work for many years to come. Instead of approaching animal communication with anthropocentric preconceptions, they set out to describe the natural behavior in objective terms, seeking to derive conclusions about the evolutionary basis of behavior. Even such severe critics as D. S. Lehrman (1953) fully acknowledge the great value of the advances which this "ethological" school has achieved. Communicatory behavior has figured prominently in this work and provided the basis for much of the theoretical discussion in the early papers of Lorenz (1935) and Tinbergen (1940). The scope has subsequently been broadened to include other types of behavior, and the "ethological" school (Tinbergen, 1951; Thorpe, 1956) now provides a rationale for the analysis of animal behavior.

In proceeding thus far, it is the author's contention that some of the special circumstances surrounding communicatory behavior have been overlooked. Close attention has been given to the evolutionary basis of visual signals and the motivation which underlies them. Less attention has been given to the nature of the actual communicatory process; to the questions raised by the process of exchange of signals between one animal and another. The psychologists' concern with this aspect leads them to a consideration of purposiveness, but this does not prove to be a productive line of attack. A strictly objective approach is required which can be applied with equal efficacy to the communication of animals and of man. This paper seeks to show that the theoretical framework presented by Cherry (1957), building especially upon the ideas of Pierce (see Gallie, 1952) and Morris (1946), provides us with such an approach which can lead to advances in our understanding of animal communication.

Semiotic: The Theory of Signs

Dissatisfaction with the results of previous attempts to separate the subjective and objective aspects of human language led C. K. Ogden and I. A. Richards, in a book called "The Meaning of Meaning" (1923), to consider the implications of the theory of signs (or symbolism as they sometimes call it) as developed by the logician, C. S. Pierce. The relationship between a word or symbol and its external referent is shown to be elusive. Perception of external objects (referents) always involves sign situations. We respond only to a part of the whole object. That part comes to represent the whole object as a kind of symbol or sign. "If we realize that in *all* perception, as distinct from mere awareness, sign situations are involved we shall have a new method of approaching problems where a verbal deadlock seems to have arisen. Whenever we perceive what we name a chair we are interpreting a certain group of data, and treating them as signs of a referent." Narrowing down the discussion to the use of language they suggest that "when we consider the various kinds of sign situations… we find that these signs which men use to communicate with each other and as instruments of thought occupy a peculiar place". This comes to bear directly on our present problem with the statement that "the person actually interpreting a sign is not well placed to observe what is happening. We should develop our theory of signs from observations of other people, and only admit evidence from introspection when we know how to appraise it."

To explain the approach of C. S. Pierce to the problem of language analysis, W. B. Gallie (1952) gives the following example. "Suppose that in any particular case we are in doubt whether some sign made by an individual A has been interpreted or understood by a second individual B. How should we set about trying to settle the question? Should we somehow or other try to discover directly what B's 'mental reaction' has been? It seems quite certain that we have no means whatever of doing this. What we would do, surely, is to try to discover whether B has made some overt response such as A's sign would justify." Cherry (1957) emphasizes the same point, that only a non-participant observer can make fully objective observations on communication systems.

The science of semiotic has arisen to deal with the kind of data that are obtained by direct, non-participant observation of communication systems. It is usually divided into three parts: *syntactics*, the formal study of signals as physical phenomena, and the laws relating to them; *semantics*, study of the "meaning" of signs; and *pragmatics*, the significance of signals to the communicants (Cherry, 1957). The application of syntactics to animal communication is clear, and great progress has been made by Tinbergen and others in this kind of analysis, especially in the sphere of visual communication (see Tinbergen, 1940, 1951, 1952, 1959). Semantics are of doubtful value in animal studies, and as Cherry points out there is considerable overlap with pragmatics, even in the sphere of human language. Pragmatics on the other hand forms the natural complement to syntactics, one defining the physical properties of signals, the other concerning itself with the role of those signals in the communicatory process, a role which we seek to establish by observing and interpreting the response which they evoke in other animals.

Animal Pragmatics

The central problem is to determine the nature of the information content of communication signals. As Cherry points out "information content is not to be regarded as a commodity; it is more a property or potential". It cannot be discussed independently from the occurrences of responses to the signal in other organisms. We thus require a means of inferring information content from the nature of the response given. We may note in passing that the information theory developed by Wiener & Shannon (Shannon & Weaver, 1949) is of no help to us here since it operates only "at the syntactical level" (Cherry, 1957). The work of C. W. Morris (1946), however, is directly concerned with analysis of human language at the pragmatic level and can give us some clues as to how to proceed.

Morris seeks to distinguish between signals which function as *identifiors, designators, appraisors* and *prescriptors.* He emphasizes that this is not an exhaustive list, and elaborates some of them further to deal with special problems of human language. The four basic categories will suffice as a basis for further discussion. We can describe each of them as conveying a corresponding type of information, provided that we can discern an appropriate response from a communicant. The categories are not mutually exclusive, so that one signal might convey one or all of the different types of information.

Morris defines the four categories as follows: "In the case of *identifiors*, the interpreter is disposed to direct his responses to a certain spatiotemporal region; in the case of *designators* the interpreter is disposed toward response sequences which would be terminated by an object with certain characteristics; in the case of *appraisors* the interpreter is disposed to respond preferentially with respect to certain objects" as manifest in a choice situation; "in the case of *prescriptors*, the interpreter is disposed to perform certain response sequences rather than others.” So identifiors may be said to signify (i.e. convey information about) location in space and time, designators to signify characteristics of the environment, appraisors to signify preferential status and prescriptors to signify that specific responses are required. This classification cuts across the division of language into emotive and referential (or symbolic) which received so much emphasis from Ogden & Richards (1923). Morris shows how his classification is subject to testing in a way that the other is not. Moreover we can see that while prescriptors and appraisors embody much of the quality of “emotive” language, and identifiors and designators are more obviously “referential”; in nature, the latter can be emotive in certain circumstances. Thus the new approach is more precise and should be regarded as replacing the older terminology, as Morris suggests.

We now have to demonstrate that this method of analysis can in fact be applied to animal communication systems. J. B. S. Haldane (1953; Haldane & Spurway, 1954) have already shown some ways in which this may be done, and the writer also made an attempt to analyse vocal communication in a small bird, the chaffinch (Marler, 1956) by a method similar to the one suggested here. A reinterpretation of those same data can serve as an illustration. In essence, given a knowledge of the response of other animals to the signal and of the other circumstances in which that same response is given, we can infer the nature of the “message” transmitted by the signal.

The song of the chaffinch is given only by the male. The species is normally monogamous, and the song is especially frequent in an unmated male, given only within his territory. An unmated female chaffinch in reproductive condition responds to repeated singing by persistently approaching the singing male, soliciting his courtship, and eventually establishing a pair bond with him. Circumstantial evidence suggests that some females learn the individual characteristics of their mates’ song, and subsequently respond to them in a preferential way. The behavioral exchanges consequent upon the female’s response to the song are confined to a sexual context and are normally evoked by what we may describe as an “appropriate sexual partner”. We may infer that frequent male singing conveys information about this particular class of objects which are the “designata” of the male’s song, in this situation. What exactly is the information content which is implied?

An appropriate sexual partner for an unmated female chaffinch in reproductive condition is *an unmated male chaffinch in reproductive condition, in possession of a territory* (within which nesting will take place), *who is close to a location occupied by the female at the same time as she is there.* We are suggesting that all of these items of information are conveyed to her by the male’s song. This does not imply that the song has any meaning for her, only that it performs selective actions upon her, appropriate to a certain input of information (Cherry, 1957). The male's individual identity may also be conveyed in some cases. To what extent can this be fitted into Morris's scheme?

"Identifiors" dispose the receiver to direct his responses to a certain spatio-temporal region. We can show that such identifying information is present in the male chaffinch's song which provides an abundance of clues for precise location of the singer in time and space (Marler, 1959). In some respects "locating" information might be a better description.

"Designators" dispose the receiver towards response sequences which would be terminated by an object with certain characteristics. Designative information is thus to be defined by the characteristics of the object normally evoking the response, in this case those of an appropriate sexual partner. This would encompass all of the items outlined above and we shall suggest in a moment that further sub-categories may be desirable.

"Prescriptors" dispose the receiver to perform certain response sequences rather than others. The response prescribed for the female chaffinch is to approach and to adopt certain postures which elicit male courtship. Prescriptors and designators may be confused in some cases because we need to know the kind of response prescribed before the object designated can be discovered. Circular reasoning can only be avoided when prescriptor and designator are contained in different signals. If they can be combined with other signals a different response can be prescribed with the same designator and the effects can be separated. When the same signal performs both functions, as seems to be common in animals, no logical separation between prescriptors and designators is possible.

Appraisors dispose the receiver to respond preferentially to certain objects. Although we have no quantitative information, the frequency with which a song is repeated probably conveys such appraisive information. Within the range of song frequencies that will evoke a response, a female confronted with two singing males may be most likely to choose the one who is singing most persistently.

A more detailed breakdown of the nature of designative (and therefore prescriptive) information is required if this system is to aid us in analysis of the evolution of animal communication systems. Most critical from the point of view of natural selection is the presence of the *species-specific* information—that the singer is a chaffinch. We can also separate *sexual* information—that the singer is a male; *individual* information—that the singer is a particular individual; *motivational* information—that the singer is in reproductive condition; *environmental* information—that he is within his territory and has no mate. The criteria by which these types of designative information may be identified are as follows.

Species-Specific Information and its Evolutionary Implications

If the response given to the signal is normally evoked only by members of one species we may infer that species-specific information is conveyed by the signal. Usually a member of the same species will be involved, since many animal communication signals play a role in reproductive isolation. Information about other species could come into this category, as for example in the signals exchanged between a commensal and its host. There are also mimics which emit signals with a false species specificity.

Some signals are lacking in such species-specific information. For example, in a situation involving acute danger male chaffinches have an alarm call consisting of a high thin squeak. It is typically given in response to a hawk flying overhead. It evokes the same response from other chaffinches as the stimulus provided by the hawk, namely, direct rapid flight to the nearest cover. However, several other small woodland birds have converged upon the same type of alarm call presumably because, as mentioned below, it is a difficult sound to locate, and so exposes the caller to a minimum of danger. Chaffinches will respond to the corresponding alarm calls of other species as promptly as to their own. Such cases of interspecific communication are very common in the woods in which chaffinches live. Thus species-specific information is not present in this call. Degrees of species specificity may be expected, decreasing to the extent that signals are of mutual value in communication within a group of different sympatric species.

A signal functioning to transmit species-specific information will be subject to certain evolutionary pressures, since there must be a minimum of confusion with signals used by other species at the same time and place. Circumstantial evidence suggests that many auditory and visual signals have been selected for specific distinctiveness (see Sibley, 1957). Conversely signals with an interspecific function may be subject to selection for convergence upon a common type—or at least to a minimum of selection for divergence. Where species specificity is required, it is desirable that, as well as being specifically distinct, the signal should also be biologically improbable and conspicuous for effective communication against a background of environmental "noise" (Lorenz, 1951). A relative lack of variability is also required among members of the same species, or at any rate of the same population, an important point when we compare signals which convey individual information.

Sexual information. Responses associated with reproduction are normally evoked by members of the opposite sex when in the appropriate physiological condition. A signal evoking such a response may be said to convey sexual information. There are, however, cases where such behavior patterns are also evoked by members of the same sex in what may be called homosexual or pseudo-sexual behavior (see Morris, 1955). The incidence of sexual information varies considerably as manifest in the extent to which the sets of communication signals of the male and female overlap in different species. The same principles often apply to visual and auditory signals, so that the more sexually dimorphic finches, for example, also show the greatest discrepancy between the repertoires of displays and vocalizations in the two sexes (Hinde 1955–6). The principles governing these variations in the prevalence of sexual information in the signals of different species have not yet been worked out.

In discussing differences between the signals produced by male and female animals, Hockett (1961) has elevated the principle of what he calls "interchangeability" to the level of a major criterion in the analysis of communication systems. He suggests that while it occurs in animals, it is especially characteristic of human language, implying that any person can theoretically reproduce sounds made by any other person. He makes a distinction between language and paralanguage (Trager, 1958) and applies the principle of interchangeability particularly to the former. However the same distinction, which seems to rest on an intuitive judgement with reference to human language, cannot be made with animals. If we regard the difference between the sexes as a means of conveying sexual information, this information is obviously present as a conspicuous and more or less consistent difference in frequency between the speech of men and women. While the auditory signals produced by women share many characteristics with the corresponding signals of men, there are also in Western Society certain unavoidable differences of pitch, unavoidable, that is, for *most* women (Potter, Kopp & Green, 1947). In this respect the lack of "interchangeability" in human speech is more striking than in some animals, since even strongly sexually dimorphic species often have some signals which are consistently identical in all respects in the two sexes.

Individual information. The transfer of individual information by a signal is implied whenever the response is normally only evoked, or most readily evoked, by the particular individual emitting the signal. The qualifications admit the possibility of appraisive information being included here, since the female chaffinch, for example, will respond to an unfamiliar chaffinch song, though she may choose a familiar song if given a choice. In many circumstances individual recognition of the signals of mates, rivals, young, and companions plays an important role in the social behavior of animals (Nice, 1943; Marler, in press).

A signal which transmits individual information is subject to selective influences different from those associated with species-specific information. The latter, as we have seen, is most readily transmitted by signals which show little variation, either in the individual or within a population of a given species. Individual information is again best conveyed by signals which vary little in the individual. But it is also a prerequisite that the signals emitted by individuals of the same species, especially within the same population, should differ from each other in a consistent manner. Circumstantial evidence suggests that there is an unduly high degree of intra-group variability in signals which are thought to be involved in individual recognition, such as visual signals originating from the head region of birds, and the songs of some species of birds (Marler, 1959, in press). Some bird songs appear to convey both species-specific and individual information by relegating the stereotyped and variable properties to different parameters of the song.

Motivational information. The last two categories of designative information, motivational and environmental, are the most difficult to define, the least understood, and perhaps ultimately the most important from an evolutionary point of view. The transmission of motivational information by a signal may be inferred if the response given is appropriate to a particular motivational state of the signaller. Such a signal conveys information about variations in the readiness of the signaller to engage in certain classes of activity, such as feeding, fighting or copulation and so on.

The male chaffinch's song evidently communicates to the female the fact that he is in a reproductive state. This condition usually lasts for about three or four months. Short-term changes in motivation may also be communicated by signals. When a mated female has built a nest and is preparing to ovulate she will allow the male to copulate at intervals for about four or five days. When actually ready for copulation she gives a special call which is restricted to this context. The male promptly approaches and mounts. Similarly the calls given periodically by the young as they become hungry, cause the parents to bring food to them.

Information about still more subtle changes in motivation can also be transmitted. Here the best evidence comes from visual signals, and to discuss them we shall again have to anticipate consideration of the divisible parts of the signal and the information they convey. Many of the communication signals used by animals are subject to what Morris (1957) has called the "principle of typical intensity". This implies that the signal varies little or not at all, with variation in the level of motivation with which it is associated. Either it is given in "typical intensity" or it is not given. Such a signal can effectively communicate presence or absence of a certain type of motivational information but not variations in degree. For many purposes this appears to suffice. In general, a male chaffinch is either in reproductive condition or he is not, and an "all-or-none" type of signal can communicate this.

Other signals do not obey the principle of typical intensity, but vary widely in form, completeness and frequency with the intensity degree of motivation with which they are associated. Visual signals used in fighting behavior are particularly prone to vary in form with slight variations in the presumed balance between the tendencies to attack and withdraw. An opponent is often highly responsive to the slight shifts in motivation which these changes convey, advancing in response to signs of withdrawal, and vice versa, and the final outcome of the fight will normally be determined in this way. On the basis of his extensive studies of the behavior of cats, Leyhausen (1956) has been able to construct a Latin square of the changes in facial expression with changes in aggressiveness and readiness to flee, including all possible combinations between the two, a remarkable demonstration of the complex array of motivational information that such graded communication signals could convey. A function of this kind obviously has profound effects upon the way in which the signals will evolve.

The signals discussed above convey what we can describe as "positive" motivational information; they enable a receiver to "make a positive prediction" of the response which the signaller is likely to give when approached. The evolution of a second class of signals has been governed by a trend towards becoming the direct opposite of other signals, as Darwin (1872) pointed out with his principle of antithesis. His classical example is the behavior of a submissive dog which can only be described as the opposite in all respects of a dog which is fighting. Many other examples of such "antithetic" or "reversed" signals (Tinbergen, 1959) have been described, having the function of conveying something like "no offense meant", and so reducing the chance of an open conflict occurring (Tinbergen & Moynihan, 1952). In the light of the present analysis we can reinterpret this function as the conveyance of negative motivational information, making it possible for the receiver to predict that the signaller will *not* behave in a certain way when he is approached. All of the cases known so far occur in potentially aggressive situations and appear to function by reducing the chances of attack or flight, or both. Negative information about readiness to attack or to flee is conveyed in most cases. Once again there are evolutionary implications which could be explored further. For example, aggressive displays usually have certain formal properties and also a certain orientation with respect to the opponent. A negative element can be introduced with respect to a certain receiver, both by reversing formal elements of the display and also by orienting away from the particular receiver. Both trends, in various combinations, can be traced in the examples given by Tinbergen (1959), ranging from simple reorientation of an aggressive display to the reversal of other aspects as well.

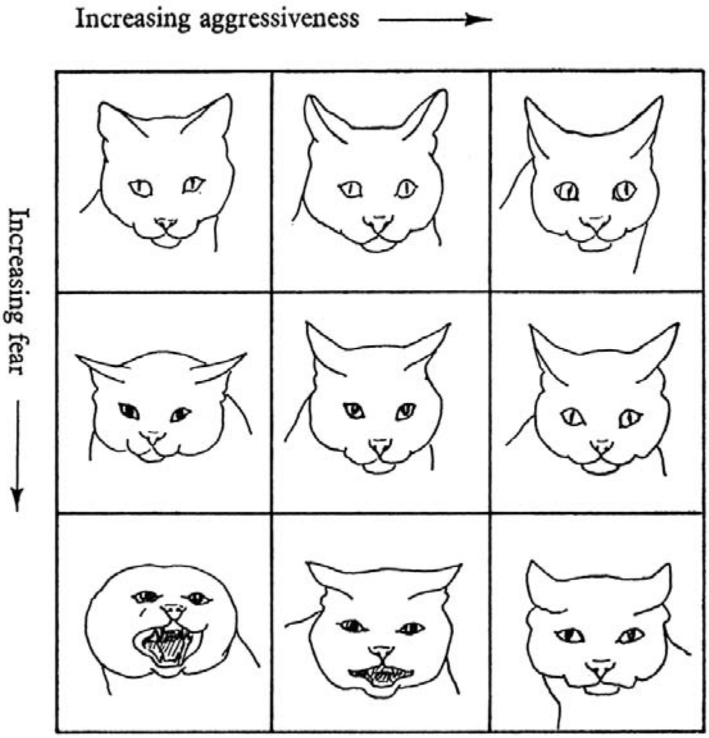


Figure 1. Changes in the facial expressions of cats associated with variations in the intensity of aggressiveness and fear. (After Leyhausen, 1956.)

Environmental information. When Morris (1946) set up the category of designators he visualized their primary role as conveyors of environmental information, encompassing as they do the characteristically human tendency to give things names. In animals we may infer that a signal has transmitted environmental information if the response it evokes is appropriate to some characteristic of the environment of the signaller at the moment or in the immediate past. The exact temporal relationship will be discussed in a later section. If, for example, a particular sound is produced in the presence of food, as occurs in herring gulls, and if others respond by approaching and looking for food, as Frings, Frings, Cox & Peissner (1955) have shown to be the case, we may infer that information about the presence of food was conveyed by the signal.

We have inferred that the male chaffinch's song conveys two items of environmental information, one positive, that he is within his territory, and one negative, that he has no mate. Other examples are mainly concerned with what are perhaps the two most important aspects of the physical environment to animals, food and predators. The use of signals conveying the presence of food is probably widespread within family groups. The mock pecking movements, by which a domestic chicken attracts her chicks to a supply of grain, are a familiar example. Special calls are probably also used in this context, though no examples are known to the author. The gull call mentioned above certainly attracts adult gulls as well as young (Frings, Frings, Cox & Peissner, 1955).

The best known signals concerned with the communication of food are the dances of honey bees, analysed in detail by Karl von Frisch (1954). The round dance communicates the distance of a food source in the neighborhood of the hive and its richness. The waggle dance, when given in the hive, also communicates the direction, as well as the distance and richness of sources which are further from the hive. This is, in a sense, another case of communication within a family group, for the worker bees are all daughters of the same queen. The dances are also used in the swarm, to communicate the distance, direction and suitability of new home sites (Lindauer, 1957). Here the dances are given, not on the vertical combs in the darkness of the hive, as in the case with the food dances, but on the surface of the swarm. Clearly the context in which the dance is given affects its communicatory significance. In both cases the signal is a mechanical one, received particularly by the bee's antenna and the mechanoreceptors at its base. The different items of information are conveyed by different aspects of the dance: direction by the angle of the waggle run with respect to the vertical; distance by the tempo of the dance; richness of the food source by the persistence of the dancing. Information about the latter might also be placed under the heading of appraisive information, since it determines the choice made between different situations, particularly in the swarm, where departure from the temporary resting place does not occur until the dancers have reached a degree of unanimity. The final decision is achieved by the scout bees discovering the best site who, by their more persistent dancing, eventually sway those who have discovered alternative but less satisfactory sites (Lindauer, 1957).

If we place the environmental information conveyed by animal signals on a specificity-generality continuum it usually appears to be relatively unspecific in nature. Information is transmitted about food but not about which particular food. It is true that foraging honey bees may pick up the scent of flowers and so convey the identity of the nectar source to members of the hive (von Frisch, 1954) but the specificity of the signal has been evolved by the plant rather than by the bee. Similarly signals concerned with communicating danger usually seem to do little more than signify different degrees of danger without specifying which environmental agent is responsible. Many small birds have different vocal signals for sudden, acute danger, such as when a hawk appears overhead, and for less dangerous situations, such as when they discover a sleeping owl, or a cat on the ground beneath them. The responses which these stimuli evoke are quite different, sudden flight to cover and cryptic behavior on the one hand; approach to a safe distance and conspicuous "mobbing" behavior on the other. However, the circumstances may greatly modify the response to a given predator. In early spring a male chaffinch will normally give the call associated with acute danger only in response to a flying hawk. But later when he has nestlings, a variety of animals will evoke this call if they come near the nest. Thus we cannot say that the call communicates the presence of a hawk. There may be animals which convey more specific environmental information. Our knowledge is so fragmentary that we cannot begin to generalize. The European willow warbler is thought to have two mobbing calls, one given to a perched hawk, the other to a cuckoo, suggesting that more specific information may be conveyed in this case (Smith & Hosking, 1955).

Conclusions on information content. Although identifiors (or locators) and appraisors occur among the communication signals of animals, designators seem to be most richly represented. Five different categories of designative information have been described, all having particular implications for the evolution of animal communication systems. Perhaps the most prominent category in human language is environmental information, the one to which investigators most often turn when they wish to compare the animals with man. The basic capacity, to convey environmental information by signals, is present in both. However, the time element in this process is significant as several authors have pointed out (Haldane, 1956; Haldane & Spurway, 1954; Hockett, 1961). In animals the delay between perception of an object in the environment and emission of a signal conveying information about that object is usually a short one. In man the delay may be extended almost indefinitely, illustrating what Hockett (1957) calls "displacement". The only well documented case involving a longer delay in animals comes again from the honey bee where the dance occurs after the forager has returned to the hive (von Frisch, 1954). Here there are finite limits to the delay, which is short by human standards in any case, and it would hardly be useful to the honey bee if it were any longer since the food supply from a given plant varies from hour to hour. Human capacities in this direction are probably unique, although one may wonder if any but the most educated observer would be able to detect such extensive time delays in animals even if they occurred.

The context may have considerable significance to the animals themselves. Hockett (1961) has pointed out how the responses of honey bees to dancing differs when it takes place in the hive and on the swarm. In speaking of the communicatory process as though it were mediated by signals alone, we have thus been guilty of over-simplification. The response evoked by a signal—and therefore the information it conveys—may vary with changes in the circumstances both of the sender and the receiver. The song of a male chaffinch is seen in a different light if we observe the response of male chaffinches instead of females. A male chaffinch intruding into another's territory will flee if he hears the owner's song, implying reception of a further item of motivational information, that the owner is ready to attack male chaffinches found within the boundaries of his territory. The response of a male in an adjacent territory will be different again, and so on. The separation of all of the factors which bear on a given act of communication is thus an imposing task. The additional possibility always exists that the signaller may be emitting several different cues at the same time, as seems to be the case in rats, for example, where olfactory, tactile, visual and auditory signals may all play a part in the female's sexual responses to the male (Beach, 1942, 1947).

Divisible Elements of the Signal

In trying to determine the role of prescriptive information in animal signals we have been confronted by the dilemma that it cannot be distinguished from designative information in signals consisting of one indivisible unit. Only when prescriptors exist in physically separate parts of the signal can an unequivocal separation be made. It thus becomes important to transfer our attention from pragmatics to syntactics to consider the physical nature of some of the signals used in animal communication.

Continuity Versus Discreteness

Attention has been drawn to the fact that some signals vary to the extent that they sometimes grade continuously into other signals; others tend to appear in an all-or-none fashion, so that they are separate and discrete from all other signals. The degree of variation observed can be correlated to some extent with the information which the signal conveys. A degree of continuous variation may occur in at least three different circumstances.

First, appraisive information appears to be most commonly conveyed in animals by signal characteristics which vary in a continuous manner. The frequency with which the chaffinch song is repeated probably conveys appraisive information to the female about the male's relative suitability as a mate (*see p. 259, above*). Similarly the persistence of dancing in the honey bee, as expressed by the number of dances given before the sequence is broken, conveys appraisive information about the richness of the food source or the suitability of a new nest site to other members of the hive. Cases may exist where appraisive information is conveyed by a discontinuous series of signals. For example, the remarkable series of postural displays given by the black-headed gull correlated with variations in the relative and absolute levels of tendencies to attack and to flee should come into this category, for while some intergrade, others are discrete, with a sudden switch from one to the other as the balance of motivation shifts (Moynihan, 1955; Tinbergen, 1959). However, it appears that this condition, which is characteristic of human language, is rare in animals.

Another function of continuously variable signals is the conveyance of subtle changes in motivational information. Some signals, as Morris (1957) has indicated, vary little with slight changes in the signaller's motivation, whereas others mirror the changes in motivation very closely (*see p. 266, above*). Particularly in fighting behavior, where the communication of such subtle motivational information can assume great importance, such variable signals are often used. Human language is in some ways less well adapted to convey such continuously variable information because of the tendency to divide continuous phenomena into discrete classes, which is perhaps one of the reasons why animal signals of this type are difficult for zoologists to describe.

Continuously variable signals also occur as a means of conveying environmental information of a continuously variable nature. The best example is again from the honey bee dances, in which both the direction and distance of the food source are communicated. The former is conveyed by the angle of the waggle run with respect to the vertical, the latter by the tempo of the dance, both varying in a continuous manner. No doubt further examples will be discovered.

We may conclude that continuously variable signals have an important role to play in the communication systems of animals. More stereotyped, discrete signals are also common and, for example, make up the bulk of the vocal signals of such birds as the chaffinch. Continuously variable signals have certain disadvantages. Their interpretation may be slow, and subject to error. Also appropriate inborn responsiveness to all properties of the signals, which characterizes the communication systems of many animals is more easy to visualize with discrete signals than with continuously variable signals. Finally there may be conflicts with other items of information conveyed by the same call. We have seen that the communication of species-specific and individual information both call for stereotyped signals, a requirement which may well override the need to convey subtle changes of motivation.

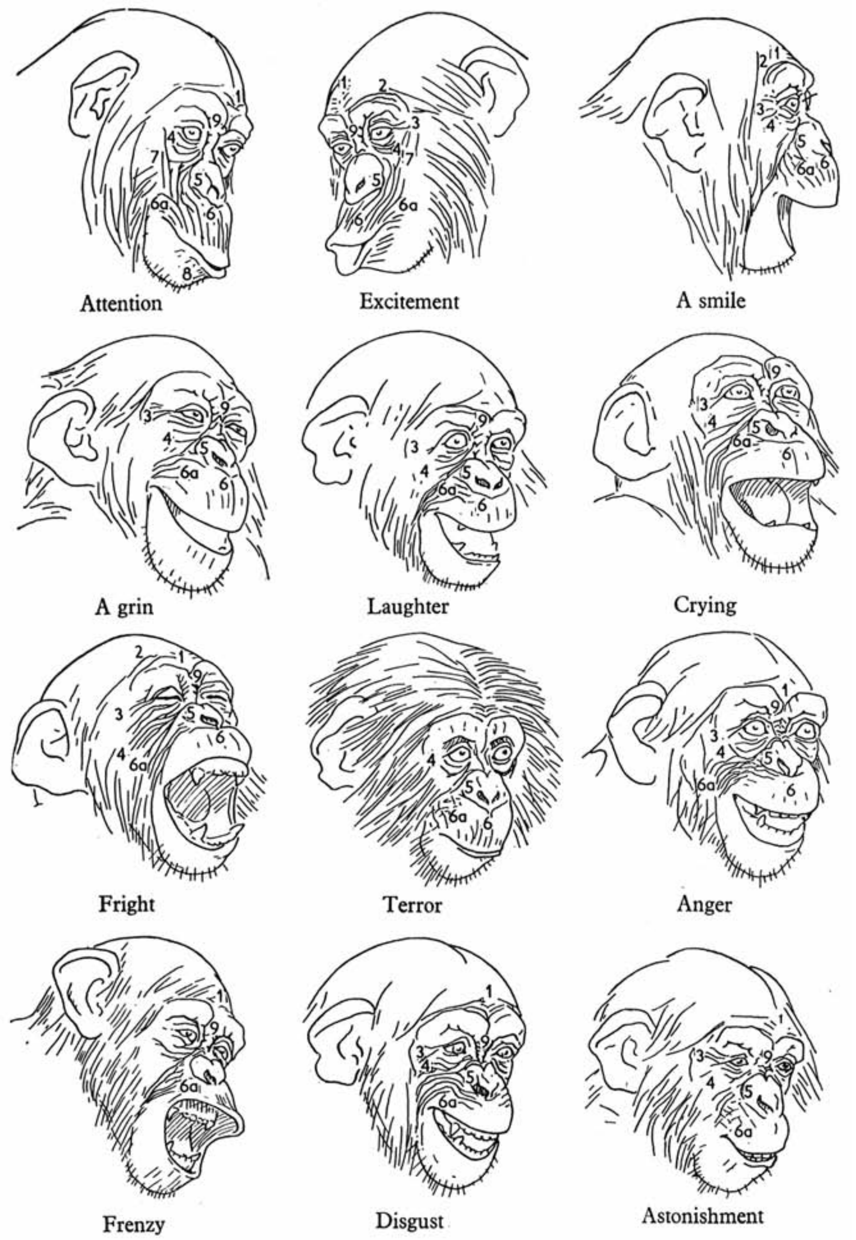


Figure 2. The facial expressions of a young chimpanzee in various moods. The creases on the face are numbered to emphasize that each one may be involved in several different expressions. (After Kohts, 1935.)

Divisibility

The impossibility of separating designative and prescriptive information hinges on the fact that in animal communication systems several items of information seem to be conveyed by one discrete, indivisible signal. We do not normally find the different items of information represented by different elements as is commonly the case in human language, where the component elements can be rearranged to create new "messages". However, this does seem to occur in some cases, particularly in visual communication signals. The facial expressions of chimpanzees probably serve as signals in intraspecific social behavior (Hebb, 1946). In describing them, Kohts (1935) took great care to point out that the same creases on the face may be involved in several different circumstances, the expressions as a whole presumably conveying different information. In her drawings, she even went so far as to number the facial lines to emphasize this point (Fig. 2). Assuming that all elements are necessary for the complete signal (which is difficult to test with visual signals), it appears that the divisible parts can be rearranged to create new "messages". In a similar way the sharing of components by different visual displays of such birds as the chaffinch may imply something similar.

Examples may also be found among vocal signals, but we have to proceed with care. Thus Hockett (1961) quotes Lanyon as presenting evidence that basic motifs in the songs of certain birds are rearranged in different ways to create new songs. A number of cases of this have been described, but there is no evidence that these recombined elements differ in any way in information content. Better examples are likely to be found in the alarm calls of certain birds. Some species have several discrete calls which are given, sometimes alone, sometimes together with other calls. The sequences of different signals may conceivably contribute to one overall signal whose information content varies with the constituents of which it is made up. If this proves to be the case, we are then approaching, at a very primitive level, the kind of lability in the manipulation of the information content of signals which is such a distinctive property of human language.

We must not assume that the lack of such lability among animals is simply a result of incapacity of the nervous system to handle such complex information. The way of life of most animals is so stringent and fraught with dangers that a high premium is placed upon quick production of brief signals, which can be accurately interpreted by receivers, often without the opportunity for previous practice. Given that the fight for survival is controlled by a limited number of factors, such as reproduction, fighting, food and predators which, as selective factors, dominate all others in their effect, there is little place in the biology of most animals for the kind of subtleties of communication which human language permits. Nor must we forget that communication is a social activity which often runs counter to the trend towards competition which characterizes most animal communities. A very elaborate social organization is required before the survival of an individual's genotype becomes so dependent upon survival of the group that natural selection will encourage individual sacrifice for the sake of the community. In most cases we may expect this to occur only within the family group which is one of the reasons for the strong emphasis on individual information in communication signals. With a more elaborate social organization and division of labor among its members, the immediate pressures upon individual survival are alleviated, and the stage is set for the exploitation of the more subtle gains arising from further elaboration of the systems of communication. The most elaborate communication system known in the animal kingdom occurs in the honey bee, whose social organization particularly from a genetic point of view begins to approach the ideal conditions we have postulated above.

Relationships Between Information Content and Signal Structure

Human language is usually regarded as consisting of arbitrary symbols, bearing no direct physical relationship to the information which they carry. The communication system is thus based upon a convention. Some zoologists have asserted that the communication signals of animals are arbitrary in the same sense (Lorenz, 1935, 1951) and many of them seem to satisfy the criteria. However, in some cases physical structure is intimately related to the corresponding designata.

The conveyance of locating (i.e. identifying) information by sound signals is directly related to physical structure, since this controls the ease with which the sound source can be located. Vertebrate animals, for example, rely primarily upon differences of intensity, phase and time of arrival of sound at the two ears. The easiest sounds to locate are those providing all of these clues, the ideal being something like a repetitive dick. This type of sound, used by many species of birds when they are mobbing an owl (*see p. 266, above*), is a readily located call serving to attract the attention to the position of the owl. Conversely the calls given when a hawk flies overhead have a different structure which minimizes the clues available for location, making the source of the sound difficult to determine. Insects with different types of receptors which respond, not to pressure changes but to the actual displacement of molecules of the medium, are able to determine the direction of sound directly by reference to the vectorial properties of sound, so that their signals are not affected by the problems of location which confront vertebrates (Marler, 1959).

We have noted that appraisive information is sometimes conveyed by the frequency or length of time for which a signal is repeated. The honey bee dances longer for rich food sources than for poor ones, which implies an iconic relationship.

With the sub-categories of designative information we are on surer ground. Consider for example some of these signals in the light of the most commonly accepted alternative to "arbitrary" which is "iconic". A degree of direct physical correspondence between the signal and its referent is implied (see Cherry, 1957; Hockett, 1961) as with a picture for example. The portion of the honey bee's waggle dance that communicates the direction of the food source conveys this environmental information in an iconic manner by transposing directly from the direction with respect to the sun, to direction with respect to the vertical (Hockett, 1961).

Some other signals conveying environmental information appear to be non-iconic. Thus the various alarm calls of birds bear no relationship to the dangers which are their designata. However their physical structure is by no means arbitrary, in relationship to the locating information which they may convey. Thus the adjectives arbitrary and iconic cannot be applied to a signal as a whole, only to the relationship between signal structure and particular items of information which they communicate.

Signals conveying motivational information may be iconic or arbitrary. Most sound signals probably come into the latter category, although sounds used by many birds and mammals in fighting, having a grating, growling or rattling quality may be related in iconic fashion to the snapping of beaks or teeth which occurs in actual combat. Visual signals which are known to have originated as what zoologists call "intention movements" (Tinbergen, 1940, 1952; Daanje, 1950), which Darwin (1872) recognized as "serviceable associated habits" are more obvious illustrations. For example, many aggressive displays undoubtedly originated through emphasis of the actual physical preparations for attack—baring of the teeth, tensing of the muscles, and so on. More than one type of motivational information may be iconically represented in the same signal, conveying information about the existence of two or more types of motivation in the signaller at the same time. Many insights into the evolution of visual signals have arisen from the Tinbergen's discovery of this phenomenon of multiple motivation in communicatory behavior.

In the same way signals conveying *negative* motivational information are not arbitrary, since their physical structure is related in an inverse manner to the structure of other signals. These constitute a special class of iconic signals. Finally the need to communicate subtle changes in motivation has repercussions on signal structure, encouraging the use of signals which vary in a continuous manner instead of being discrete, in the appropriate circumstances.

Sexual information may equally well be arbitrary or iconic. The red breast of the reproductive male stickleback, which functions as a signal (Tinbergen, 1951) is arbitrary, whereas the swollen belly of a gravid female, also a signal, is iconic. Individual information also may be arbitrary or iconic. Arbitrariness becomes prominent with species-specific signals. It is no accident that Lorenz's (1951) emphasis on arbitrariness was largely derived from intensive study of the plumage and courtship behavior of ducks and other birds, as they play a role in reproductive isolation, all with a strong emphasis upon species-specific information.

The requirement here is that the signal should be readily distinguished from those of other species likely to be transmitted at the same time and place. The way in which they differ is arbitrary, as long as it is readily perceptible to members of the species. The evidence suggests that this has resulted in specific divergence in a wide variety of animal communication signals which function in reproductive isolation of the species. Even here the signals are not entirely arbitrary, since they are excluded from overlap with the signals of other species.

It will be clear from the above discussion that the classification of signals as either iconic or arbitrary is unsatisfactory. A signal may fail to be entirely arbitrary in several ways, which do not all conform closely to the usual definition of iconic. The structure can, however, be related in different ways to the different types of information being conveyed, be it locating, appraisive, species-specific, environmental, motivational and so on. It may be an aid to further progress if we treat signal structure from this point of view, instead of placing all non-arbitrary signals in the iconic category.

Conclusions on the Evolution of Signals

A detailed review of the evolution of the communication systems of animals is beyond the scope of this paper. We would need to present comparative data, on a much larger scale, and much of the evidence has been reviewed in recent papers (e.g. Tinbergen, 1952, 1959; Morris, 1956, 1957; Marler, 1959) together with discussion of the special problems which arise with the different sensory modes. We may note that evolution from iconic to arbitrary signals is probably quite a common occurrence, as part of the process known as ritualization (Tinbergen, 1952; Blest, in press). The ontogenetic basis of sound signal systems has been considered in several recent papers (Sauer, 1954; Thorpe, 1958; Messmer & Messmer, 1956; Thielcke-Poltz & Thielcke, 1960; Lanyon, 1957) establishing that while the majority of signals are genetically controlled, some are passed on by the learning of traditions. In contrast we know almost nothing about the ontogenetic basis of responsiveness to signals. Learning probably plays an important role here, even in lower animals. All of these issues need to be considered in a complete analysis of the evolution of the communication systems of animals.

The aim of this essay is more restricted. It seeks only to demonstrate that by using the response evoked by signals as an index, we can derive a picture of the kind of information conveyed. An attempt is made to classify some of the types of information involved, and to show that the effects of natural selection upon the evolution of signals may be clarified by such an approach. The categories suggested are neither final nor exhaustive. The existing knowledge about animal communication is so scanty that we have little to use as a basis. Nevertheless we may make more rapid progress if we approach animal communication systems as a whole instead of treating each aspect as a separate issue. The problems occupy a unique position in the study of the evolution of behavior. It is a challenge for us to try to solve them, even at the most elementary level.

This paper results in part from a research program supported by a grant from the National Science Foundation. It has benefited greatly from the criticisms of Drs. F. A. Beach, C. Cherry, C. F. Hockett and O. P. Pearson.

References

Beach, F. A.
1942 J. *comp. Psychol.* 33, 163.
Beach, F. A.
1947 *Physiol. Rev.* 27, 240.
Beach, F. A.
1959 *Amer. Psychol.* 15, 1.
Blest, A. D.
In press In: “Modern Problems of the Behaviour of Man and Animals”. Cambridge University Press, London.
Cherry, C.
1957 “On Human Communication”. Wiley, New York.
Daanje, A.
1950 *Behaviour*, 3, 48.
Darwin, C.
1872 “The Expression of the Emotions in Man and Animals”. Murray, London.

Frings, H., M. Frings, B. Cox, and L. Peissner
1955 *Wilson Bull.* 67, 155.
Gallie, W. B.
1952 "Pierce and Pragmatism". Pelican Books, Harmondsworth, England.
Haldane, J. B. S.
1953 *Diogenes*, 4, 3.
Haldane, J. B. S.
1956 *Science Progress*, 175, 385.
Haldane, J. B. S. and H. Spurway
1954 *Insectes Sociaux*, 1, 247.
Hebb, D. O.
1946 *Psychol. Bull.* 53, 88.
Hebb, D. O. and W. R. Thompson
1954 In: G. Lindzey (ed.), "Handbook of Social Psychology", Vol. 1. Addison-Wesley, New York.
Hinde, R. A.
1955–6 *Ibis*, 97, 706; 98, 1.
Hockett, C. F.
1961 In: Lanyon, W. E. & Tavolga, W. N. (eds.), "Animal Sounds and Communication". A.I.B.S. Symposium Proceedings. A.I.B.S. Washington.
Kohts, N.
1935 *Sci. Mem. Mus. Darwin., Moscow*, 3, t. Russian with English summary.
Lanyon, W. E.
1957 *Publ. Nuttall Ornithol. Cl:* 1, 1.
Lehrman, D. S.
1953 *Quart. Rev. Biol.* 28, 337.
Leyhausen, P.
1956 *Handbuch Zool., Berlin, Bd. VIII*, 10(21), 1.
Lindauer, M.
1957 *Nature, Lond.* 179, 63.
Lorenz, K. Z.
1935 *Ornithol.* 83, 137, 289.
Lorenz, K. Z.
1951 *Symp. Soc. exp. Biol.* 4, 221.
Marler, P.
1956 *Ibis*, 98, 231.
Marler, P.
1959 In: Bell, P. R., (ed.), "Darwin's Biological Work". Cambridge University Press, London.

Marler, P.
In press — In: Blair, W. F. (ed.), "Vertebrate Speciation". University of Texas Press.

Messmer, E. and I. Messmer
1956 — *Z. Tierpsychol.* 13, 341.

Morris, C. W.
1946 — "Signs, Language and Behavior". Prentice Hall, New York.

Morris, D.
1955 — *Behaviour*, 8, 46.

Morris, D.
1956 — "The function and causation of courtship ceremonies". Fondation Singer Polignac Colloque Internationale sur L'Instinct, 1954.

Morris, D.
1957 — *Behaviour*, II, 1.

Moynihan, M.
1955 — *Behaviour Suppl.* 4, 1.

Nice, M. M.
1943 — *Trans. Linn. Soc. N.Y.* 4, I.

Ogden, C. K. and I. A. Richards
1923 — "The Meaning of Meaning". Routledge and Kegan Paul, London.

Potter, R. K., G. A. Kopp, and H. C. Green
1947 — "Visible Speech". van Nostrand, New York.

Revesz, G.
1956 — "The Origins and Prehistory of Language". Longmans, Green and Co., London.

Sauer, F.
1954 — *Z. Tierpsychol.* II, 10.

Shannon, C. E. and W. Weaver
1949 — "The Mathematical Theory of Communication". University of Illinois Press, Urbana.

Sibley, C. R.
1957 — *Condor*, 59, 166.

Smith, S. S. and E. Hosking
1955 — "Birds Fighting". Faber and Faber, London.

Stevens, S. S.
1950 — *J. acoust. Soc. Amer.* 22, 689.

Thielcke-Poltz, H. and G. Thielcke
1960 — *Z. Tierpsychol.* 17, 211.

Thorndike, E. L.
1911 — "Animal Intelligence". Macmillan, New York.

Thorpe, W. H.
1956 — "Learning and Instinct in Animals". Methuen, London.

Thorpe, W. H.
1958 *Ibis*, 100, 535.

Tinbergen, N.
1940 *Z. Tierpsychol.* 4, 1.

Tinbergen, N.
1951 "The Study of Instinct". Clarendon Press, Oxford.

Tinbergen, N.
1952 *Quart. Rev. Biol.* 27, 1.

Tinbergen, N.
1959 *Behaviour*, 15, 1.

Tinbergen, N. and M. Moynihan
1952 *Brit. Birds*, 45, 19.

Tolman, E. C.
1932 "Purposive Behavior in Animals and Man". Appleton-Century-Crofts, New York.

Trager, G. L.
1958 *Stud. Linguistics*, 13, 1.

Von Frisch, K.
1954 "The Dancing Bees". Methuen, London.

Animal Communication and the Study of Cognition*

W. John Smith

Many contributors to this volume have pursued Griffin's suggestion (e.g., 1976, 1985) that behavior involved in communicative events should provide perhaps our most ready access to the mental experiences of nonhuman animals. The behavior of both signallers and individuals responding to signals can indeed provide clues about how individuals represent to themselves the information they process during communication. However, interpreting these clues is a difficult challenge.

Evidence provided in this volume bears significantly on both issues that are fundamental to gaining understanding of how cognitive processes operate in communicating. On the one hand, we need to discover certain basic features of signalling: both how individuals select formalized signals to perform and what their signals "are about"—the referents of signals. On the other hand, we also need to discover how recipients of signalled information devise their responses to it. This issue is not independent of the preceding because the cognitive bases of responding to signals cannot be understood without knowledge of all the kinds of information each signal makes available. The issue is made more complex because responding is context-dependent. Many kinds of information from many sources must be selected, attended to, ranked, and dealt with together by an individual when formulating a response to a signal.

In this chapter I discuss issues of both performing and responding to formalized signals (i.e., to acts specialized to make information available, hereafter simply termed signals). A principal aim is to promote more awareness of methodological and conceptual limitations that restrict the conclusions we can draw from certain kinds of research. For instance, interpretations have been proposed in which individual animals bias, perhaps intentionally, their use of signalling to different "audiences" in order to inform, withhold information from,

---

* From: Smith, W. John 1991. Animal communication and the study of cognition. In: Carolyn A. Ristau, and Donald R. Griffin (eds.). *Cognitive Ethology: The Minds of Animals: Essays in Honor of Donald R. Griffin*, 209–230. Hillsdale, N.J: L. Erlbaum Associates.

or even mislead those other individuals. These proposals require the referents of the signals in question to be food or predators (see section on Selective Signalling). If the referents are (or include) behavior, then the interpretations are not likely to be applicable, and in these cases there are reasonable candidates for behavioral referents. Investigation has been hampered, however, by misunderstandings of the ways in which signalling acts correlate with and provide information about other actions of signalling individuals, by a confounding of information about behavior with that about the internal states of signallers, and by a tendency to experiment with responses to signals before completing sufficient research on the signalling individuals. These experiments can be powerful, but their limitations must be understood. Part of the problem arises in underestimating the complexities of context-dependent responding to signals including the use of information from experience (i.e., information stored in memory). Animals responding to signals appear to use information from many sources, and in formulating and testing predictive scenarios they may employ cognitive operations of appreciable complexity.

Signalling

Research on cognition has focused in part on the conditions under which animals signal. Conditions have been construed primarily in terms of stimuli that elicit signalling or of the presence, absence, and behavior of different individuals that could be affected by the signalled information. A major goal of this research has been to understand the extent to which signallers behave selectively. Another goal has been to ask to what extent nonhuman signalling is "symbolic" or emotive, and this has required investigation of referents of signalling. In some papers, behavioral referents have been confounded with or reduced to information about internal states, for example, when seeking to show (via experiments on responses to playback of recorded vocalizations) that external referents have primacy.

Selective Signalling

To what extent do animals have the flexibility to alter their signalling so as to affect other individuals' responses? Griffin has proposed that signallers might sometimes choose which of their signals to perform, selecting them in accordance with the effects each can have.

There are examples of interspecific signalling being adjusted with respect to its effects. For instance, Pepperberg (1981, 1987, this volume) has shown that, at least for English words taught to a parrot in a socially rewarding situation, the parrot has the flexibility to choose among signals. Certain species of birds and snakes have been shown to have selective control over aspects of signalling done toward predators. Plovers (Ristau, this volume) monitor a human near their eggs or chicks and adjust the directions in which they move while performing "distraction displays" such that the responding human is led away. Plovers also adjust the intensity of their actions on the basis of experience with different humans. Hognose snakes monitor the attentiveness of humans who attack them and choose when to terminate their "death-feigning" performances (Burghardt, this volume).

Choice might also be seen if an individual determined whether it signaled in accordance with the presence, absence, or identity of a second individual. "Audience" effects of this sort have been reported in recent work both on vervets and on what are termed "alarm" and "food" calls of domestic fowl. However, the results are subject to more than one interpretation. What appears to be flexibility in these cases may simply be a product of our incomplete understanding of the referents of the signals. That is, it is possible that the signals refer less to predators or food than to behavior the signaller may perform—behavior that differs in probability as interactions are accommodated to different companions. If so, different audiences may not elicit choices about whether to signal. To explain this possibility it is necessary to develop, briefly, a couple of examples.

First, domestic fowl and their jungle fowl ancestors (Collias, 1987; Collias & Collias 1967, 1985; Stokes & Williams, 1971) utter what has been termed a food call as part of a signalling act known as "tidbitting." In experiments with this signalling, Marler, Dufty, and Pickert (1986a) report that the probability of a male with a mealworm uttering the call was affected by other birds: If an unfamiliar rather than a familiar female were present, he was more likely to call, and he would not call in the presence of a male. Further, males called in 67% of the trials in which the only stimulus was a nonfood item; a hen approached in 46% of these cases (Marler, Dufty, & Pickert, 1986b). Marler's interpretation (this volume; Marler et al., 1986b) is that cockerels choose whether to call depending on their audience and may even intentionally choose to deceive, particularly strange females, when no food is present. Both conclusions depend on the assumption that food is the referent of the call.

An alternative possibility is that certain foods, although not necessary, can contribute to satisfying the set of conditions for calling; there may be at least three conditions. Based on descriptions by Stokes and Williams (1971), Collias and Collias (1985), Collias (1987) and others, these are: (a) the sight of an appropriate audience or the sound of another individual uttering this call; (b) some spatial separation between the signaller and its audience; and (c) a feature that keeps the signaller from going to its audience but may not interfere with attracting that audience. This last feature can be positive (e.g., the signaller finds a site with special food and stays there) or negative (e.g., an intervening territorial boundary or the presence of a competitor near the appropriate audience individual). The restraining feature appears to be centrally involved in the "courtship" functions of the signal, which depend on attracting a female to come to a male. (The signal has other functions, in other kinds of events, and all may depend on eliciting approach.)

The consistent correlates of this call may be behavioral. The accounts mention some behavior that is typical of an individual who calls: (a) It stays where it is while calling; (b) it interacts with an individual who joins it (the interaction can take various forms, not including attack); and (c) it may peck at food or other small items if these are present, but will not ingest them during a bout of calling. Thus the call appears to make available information predicting that a calling individual will interact in some positive way with an individual who joins it, although it will not (at least while calling) move to join another individual. (Note that all these predictions are about the caller's *own* behavior, not about the behavior of individuals who may respond.) As with all other animal signals, the predictions of behavior are conditional. That is, what occurs depends on how each event develops, much of which depends on what other participants do.

Under this interpretation, information about food may be made available less by the call itself than by a recipient's memory of experiences in which it was shown and given access to food by a bird who was uttering the call. Whether food or a set of behavior patterns is the referent cannot be resolved on the existing evidence. Food is not a consistent correlate (although perhaps it is of some as yet undescribed variant form of the call). Possible behavioral correlates need more thorough study, and the full range of circumstances within which the call is uttered needs to be considered.

If the call's referents are (or include) behavior patterns, however, when an individual is not likely to perform such behavior it will not utter the call. If that behavior is performed relative to other individuals (e.g., by foregoing approach and yet interacting nonaggressively with them should they approach), then different classes of individuals will elicit the call with different frequencies. Males might not elicit it at all, and females who are not socially bonded to the signaller might elicit it more readily than his mates would.

This is not what has been implied by the term "audience effect", which prejudges the issue. Instead, whether the call is uttered may depend not on an individual's appraisal of the effects calling may have on some other individual's behavior, but on the ways the signaller itself may behave. If the call's referents are behavioral, assessment of effect need not be invoked to explain different propensities to signal in the presence of different individuals.

A second, potentially simpler example involves "alarm calls" of male domestic fowl. These are uttered more in the presence of an audience individual than when a lone cockerel sees danger (Gyger, Karakashian, & Marler, 1986). The authors interpret this difference as evidence that a signaller chooses whether to call (Marler, this volume). That interpretation depends on the assumption that the referent of this vocalization is indeed a predator.

An untested possibility is that the referent is or includes a set of behavior patterns of the signaller. For instance, suppose that a fowl on perceiving a source of danger must choose between fleeing and freezing. A lone individual might do well to freeze, but a cock with an unalerted companion nearby would be at risk if the latter's movements gave away their position. Such a companion should bias the cock more toward fleeing instead of freezing. If the danger were distant and the cock did not flee immediately, it might well vacillate. At this point it might call. This hypothetical construction of the event is basically an elaboration of the *cave* postulate of Dawkins (1976).

By this conjecture, the call has as referents freezing, fleeing, and behaving indecisively (e.g., vacillating and similar behavior, see Smith, 1977: 106–108). Only one such act can occur at a time, and they are listed here in increasing order of their probability of being performed by a signaller after it calls—if the situation does not change. Freezing could become the most probable again if the cock's companion froze or fleeing if the companion fled: The predictions would be conditional.

A companion of either gender should elicit these calls from a cock when danger appears just as Gyger et al., 1986 found. A hen, much more camouflaged than a cock, might almost always be biased much more toward freezing if she saw a passing predator and thus would rarely call—again as was found.

Do cocks and hens behave as suggested here? The best way to detect the correlates that imply behavioral referents is not to make suppositions about what they might be and then test for them but first to observe signallers: to see what fowl do when uttering an alarm or food call. Detailed observation of signallers' behavior is often not an easy task because (a) behavioral correlates are conditional, (b) there are probabilistic relations among the several correlates of any one signal (see Smith, 1977: 127–133), and (c) the kinds of behavior that correlate may not fit our preconceptions and thus may not be immediately recognizable. Preconceived categories of behavior must be questioned continuously and modified or replaced as necessary, and a considerable range of events must be studied. Nonetheless, inferences cannot safely be made about conscious, perhaps manipulative use of signalling without understanding what information is being signalled (or withheld). Any attempt to identify the referents of signals must encompass all reasonable possibilities and explore a full range of alternative explanations of results before it can be used as a basis for investigating cognitive processes.

The Referents of Animal Signalling

Each formalized signal has multiple referents: (a) several kinds of behavior (plus their probabilities and other variables), (b) physical characteristics of the signaller (e.g., its species and other identities), and (c) for some signals, external stimuli to which the signaller is responding. To explore cognitive processes in communicating, or the possibility of deceptive signalling, an ethologist must usually be aware of most or all of the referents of a signal. This requires considerable effort to discover the nature and range of what correlates with performing that signal.

Evidence for each behavioral correlate of a signal may require the most prolonged effort because it develops only after signallers have been observed repeatedly. The behavior can defy accurate description and categorization until it has been seen in many kinds of events. The probabilistic and conditional features of each correlation cannot be grasped without benefit of many and diverse examples. However, if an external stimulus such as a predator or resource is a referent of a signal, then whenever the signal occurs the signaller should have detected the stimulus. (It is assumed that vervets, for instance, do not use their "leopard" call "conversationally". Additionally, in practice it is necessary to allow for inevitable mistakes by signallers in their perception of stimuli. In some cases it may also be necessary to allow for a realistically low level of deceptive intraspecific signalling, but this problem is only beginning to be explored.) The very high correlation between signal and stimulus should make external referents more evident, and perhaps more readily testable, than are behavioral referents.

The search for behavioral referents of signals is being conducted differently in different studies, particularly in cases in which analyses are focused on external correlates of signalling. For instance, in some cases, each category of signal has been found to provide information both about external stimuli to which a signaller is responding and also about the signaller's fleeing, monitoring, approach, and other behavior (Owings & Leger, 1980, working with variant forms of the chatter of California ground squirrels). In yet other cases, attempts have been made either to show that external referents are primary (i.e., are more significant to animals responding to the signal than is information about signaller behavior, see Gouzoules, Gouzoules, & Marler 1984, 1985) or to suggest that because no single class of behavior such as fleeing inevitably accompanies the signal, "the" referent is external (Gouzoules et al., 1985: 85).

Several problems appear in the latter attempts. Misunderstandings over the relations between signals and their behavioral correlates have led to confusion over symbolic and emotive uses of signalling. Related to this problem, information about behavior has sometimes been confounded with (or inappropriately reduced to) information about internal states. Further, experiments have concentrated on the responses animals make to signals, using these responses as sufficient indicators of the primary kinds of information provided by those signals.

Animal Signals as "Symbols"

The referents of animals' signals can be variously categorized. For example, they may be viewed as comprising signalers' behavior or physical characteristics or as external stimuli to which signallers are responding. A different sort of categorization has been an attempt (e.g., Gouzoules, et al., 1985, Marler 1984, Seyfarth, Cheney, & Marler 1980a) to clarify cognitive representations by distinguishing between "symbolic" and "affective" uses of signals (better: symbolic vs. emotive, see Ogden & Richards, 1946). In human communication, symbolic use involves signalling about referents per se, whether these are behavior patterns, physical characteristics, or external stimuli. Human emotive use, on the other hand, involves signals less for informing about referents than as devices for what Ogden and Richards termed evoking feelings and attitudes—closely akin to what traditional ethologists called the "releasing" of emotional states. In practice, both uses of signalling can occur simultaneously because individuals can have emotional responses to symbols.

Many ethologists working with the communication of at least vertebrate animals have recognized limitations both of the releaser concept and of current understanding of emotional (affective) states, and they have found it useful to concentrate largely or wholly on symbolic signalling. Why, then, should the issue of distinguishing symbolic from emotive signalling (which can be viewed both as an issue of referents and of the ways in which recipients of signals respond) arise so recently? The reasons seem to lie both in misunderstandings of the relationships between signals and their behavioral referents and in a failure to realize that a behavioral referent is not just a transform of a motivational or affective state. Involvement of such states in communication might entail considerable emotive use of signals, but providing information about behavior patterns employs animal signals as symbols.

There is some basic misunderstanding over just what the relation is between formalized signals, such as displays, and those other actions of a signaller that are referents of signals. The problem can be seen in a criterion put forth by Marler (1984): "If an alarm call is truly a referential symbol it should be potentially dissociable from acts of fleeing" (p. 354). By dissociable he meant that an individual uttering a call would not always flee. In fact, individuals do not always flee after calling—not just in the case of vervets but in ground squirrels and, indeed, in *any* well-studied case of which I am aware. Fleeing is simply one of several options that become predictable from such a call. Other options may include pausing to monitor or continuing with a previous activity that was interrupted by calling; the particular conditions of each event determine whether escape, monitoring, or some other alternative follows calling (Smith, 1977, 1985). No single class of behavior occurs as the exclusive and inevitable correlate of a signal.

Far from being exceptional, the relation Marler's criterion requires is perhaps universal. It appears that few or no animal signals have one-to-one correlations between their performance and the occurrence of any of their behavioral referents. They cannot. Signals are usually performed while a signaller is selecting among alternative courses of action and, as a result, each signal correlates with more than one kind of behavior. A signal permits prediction of various alternative actions each with a probability of occurring that is relative to the probability of each of the others (Smith, 1977 e.g. pp. 87 and 106-108, plus numerous examples in chapters 3 through 5; the work of ethologists making motivational analyses also supports this conclusion, see chapter 8 and also Hinde, 1985a, 1985b). Which of a signal's behavioral referents is most likely to appear in any particular event can be predicted only approximately without information obtained from sources contextual to the signal, and even then predictions fail if conditions change. Thus, the idea of "severing … the link between alarm call and escape behavior" (Seyfarth, Cheney, & Marler 1980a, Seyfarth & Cheney, 1982, Gouzoules et al., 1985: 85) is unrealistic. There was no simple one-to-one link to be severed.

Until recently, most of what ethologists learned about the correlates of signalling was about behavior. The main exception was the information supplied about resources by honey bees in their dancing. Nonetheless, external referents were not thought to be unlikely in principle (Smith, 1977: 73–74). The literature contained various supposed examples of food calls, hawk alarm calls, and the like. Although there was a dearth of adequately detailed studies, recent work is more convincing. External referents have been studied by Owings and Leger (1980), Seyfarth, Cheney, and Marler (1980a, 1980b), Gouzoules et al. (1984), Dittus (1984) and others, although not all studies are fully definitive.

Does demonstration of correlations between formalized signals and classes of predators or resources imply the discovery of symbolic signaling? No. Symbolic signalling has been shown over and again by demonstration of signals with behavioral referents. Recognizing external referents can add to our understanding of the kinds of information about which animals signal, but it is a fundamental mistake to claim that all of our previous knowledge has been simply about emotive communication. The mistake hinges upon a confounding of information about behavior with that about internal state.

Behavior vs. Internal State

In presenting cases for the discovery of external referents (Seyfarth et al., 1980a, 1980b) or the primacy of such referents (Gouzoules et al., 1984, 1985), the authors assessed the possibility that the signals might also have behavioral correlates. The attempts were marred by the notion that behavioral correlates would entail emotive signalling, and the discussions confounded an individual's actions with the internal states that underlie behavior. This confounding has serious consequences (Smith, 1981) such as diverting attention from the ways in which signalling makes a signaller's behavior more predictable. The confusion also entangles behavioral analyses unnecessarily in constraints inherent in severe limitations of the current understanding of motivational states.

The error perhaps arose because in the earlier traditions of ethology, behavioral correlates of signalling were used predominantly as a basis for inferring underlying motivational (and sometimes just emotional) states. The practice still persists to some extent. Marler (e.g., 1984) has argued that most attempts to identify the emotional states of signallers have not been productive. (He did not deal with the broader issue of motivation, but the case is similar.) Griffin (1985) implied a comparable assessment in labelling this the "groans-of-pain" (p. 620) interpretation of animal signalling.

These criticisms are by no means new. Recognition of inadequacies of the traditional interpretation of signals was basic to the development of an approach that seeks to analyze the information made available by signalling. Neither Marler nor Griffin deals adequately with this "informational" alternative. It is as if turning away from motivational interpretations also requires disregarding the behavioral correlates of signalling. But there is abundant evidence for behavioral correlates. Signalling thus does make information available about the behavior of a signaller. In fact, information about behavior may account for most of the information provided by animal signals. To deal with its significance we need not interpret either motivational or emotional states of signallers.

Informational and motivational perspectives for research differ greatly and have been contrasted by Smith (1977: chapter 8, in which their compatibility is also evaluated). Both perspectives seek correlations between signalling acts and other behavior of signallers, but the results are interpreted differently (and the informational approach also seeks correlations other than behavioral). Motivational analyses ask Tinbergen's causal question about internal states of individual organisms. In this case: What are the immediate causes of signalling behavior? (Cognitive studies also ask this question but shift the focus from motivational states to mental processes.) In contrast, an informational analysis asks what the performance of a signal by one individual makes known or predictable to other individuals. For example: What classes of the signaller's behavior become conditionally predictable when a signal is performed, and how may each be enacted (e.g., how intensely, how stably, in what direction, and with what probability relative to the others). Questions about information and predictability seek to understand what signalling contributes to the organization and running of social interactions. That is, they address social mechanisms rather than the internal workings of individuals.

In the extreme, confounding behavior with internal states takes the following form. First, because behavior is (by definition) motivated, the argument implies that analyses of the information made available about behavioral correlates of signals are nothing more than analyses of motivational causes of signalling and should be reduced to them. Yet the interpretation of signals in terms of their behavioral referents is no more "motivational" than is the interpretation of external referents. Both are attempts to understand the information that can be gleaned from a signal's performance. Neither is directly concerned with the internal states and processes of signalling individuals, even though either can be used in studies of internal mechanisms.

Second, after inappropriately reducing behavior to motivation, the narrower terms "affect" and "emotion" have been substituted (e.g., Green & Marler, 1979; Marler, 1984; Seyfarth, 1984; Seyfarth et al., 1980a). Smith (1985: 57–58) has argued that this narrowing of focus from motivation to emotion is inappropriate even for causal analyses. Third, "arousal", a visceral state presumed to underlie emotions, has then been substituted for affect (and all these interpretations even erroneously attributed to me). Proponents of this argument contend that if different signals provide different information about affect, then they must also differ in the level of arousal that underlies each. Tests are then used to show that signals do not differ predictably in the level of arousal they elicit from responders (e.g., Gouzoules, et al., 1985). Note that the tests shift the focus from signallers to responders. These tests, however, do not bear on the initial point of comparing behavioral with external referents. The whole line of argument has gone far astray.

Postulates that signals simply or primarily reflect different levels of arousal are not remotely adequate to account either for the known richness of the behavior correlated with signals (Smith, 1977) or for the complex ways in which signals differ from one another in their sets of behavioral correlates *(message assortment*, p. 176-180). Even supplemental information that signals provide about the "intensity" with which their behavioral referents may be performed (ibid.: 133–134) is much more complex than implied by "level of arousal." (Intensity measures differ for different acts and signals, and they need not all vary concordantly: A movement performed with great vigor may nonetheless be incomplete.) Thus, reduction of behavioral referents to any notion as simplistic as levels of arousal is not realistic. It is not appropriate to claim that behavioral referents are secondary or questionable simply because no correlations with arousal levels (of signallers or responders) can be demonstrated.

Responses as Criteria for Primacy of Referents

Gouzoules, Gouzoules, and Marler (1984, 1985: 81–82) offered the suggestion that "An external referent is the primary information conveyed..." (p. 81) by a signal if, in the absence of all controllable contextual sources of information, individuals can respond as if informed of this referent. But a recipient of a signal should have much less uncertainty about external than behavioral referents. As previously argued, the former should occur whenever the signal does, whereas the latter are probabilistic and conditional: Each kind of behavior occurs in only some of the events in which a signal is used.

The real distinction may thus be less in primacy than in degree of certainty, and even that difference should not always be decisive in the real world. This is because it is reasonable to suppose that animals responding to signals may not use all of the information made available in any one event but may select (or give most weight to) that which appears most pertinent (Smith, 1977: 288). Sometimes they may find that information about external referents is more relevant to them than is information about behavior, but they may also find the reverse.

For instance, imagine that a young vervet utters an "eagle alarm" call. Even if the call makes available information about both predators and the probable behavior of the signaller, a recipient with few other sources of information available about the immediate event might give priority to that about predators. Effectively assuming the worst, influenced both by recall of past events and by its inability to see the caller (and thus to be directed toward the alarm-evoking stimulus), it would flee. However, a recipient with others sources of information might treat the signal as if other referents were more salient. If the mother of the young vervet saw that a stork rather than an eagle had elicited the call, she might respond to information predicting that fleeing (to her or into bushes, Seyfarth & Cheney, 1986) is among the probable sequelae. She might then act to accommodate or fend off her child or restrain it before it disappeared unnecessarily into the bushes. These two recipients, differing in the information available to each from sources contextual to the signal, could find different referents the deciding factors in responding to the same event. Whether such flexibility exists to respond selectively to the multiple referents of a signal has yet to be tested.

The chief problem with using responses to signals as indicators of the information (or the salience of the information) made available by signalling is that responses to signals are always context-dependent. More information than that provided just by a signal is used in generating a response. This problem can affect even experiments in which contextual sources of information are minimized as is discussed in the subsequent paragraphs.

What are the Referents of Signals?

It appears that both behavioral and external referents will continue to be found, at least sometimes, both kinds in the same signal. External referents may continue to be found primarily for signals performed when the signallers or the referents are distant from appropriate recipients of the information (Smith, 1986: 316), that is, in conditions in which those recipients are least likely to detect the external stimuli themselves. Even then, it is possible that information about external issues may often come not from signals but from sources contextual to them. Behavioral referents may continue to be the more common class revealing private information that can be important to the management of social interactions. Only further research will tell.

Definitive interpretation of the referents of animals' signals may be no more practical than are definitive lexical definitions of the words of our languages. This may not be a serious limitation, however. We need only be sufficiently precise to be able to distinguish among important alternatives. We get by in speech with fuzzy definitions; there are costs, but we can usually make our communication work. That we should need a superior understanding of other species in order to study their cognitive processes seems unlikely.

An admonition I made earlier remains fundamentally important. To the extent that we focus on single classes of correlates of any display (e.g., on an external stimulus or on a single kind of behavior), we will have only a "grossly oversimplified" understanding of that signal's informative potential (Smith, 1977,

p. 87). Certainly particular correlates can be studied in isolation, but the limits of what can be concluded from such work must be clearly recognized.

If these limits are underestimated, attempts to understand cognitive mechanisms will founder. This is the point: Until we can learn the full range of information that signals contribute, we can understand neither the cognitive bases of social communicating nor subtopics of current interest such as the extent and nature of deceptive misinforming.

At this stage it appears that we need to reach fuller agreement on necessary and productive research procedures, both observational and experimental, and on the interpretation of observational and experimental evidence. It would also be enormously helpful to come to general agreement on basic terminology. Such key words as meaning, response, context, and others are each employed in more than one way, and this generates confusion.

Responding to signals

There remains the second part of the problem of studying cognitive aspects of communicating: to understand how a recipient of a signal devises its responses. In this we must deal with several issues: (a) the sources of information available to recipients, (b) the ways in which recipients may construct mental scenarios, (c) the information that recipients take from each source, and (d) the nature and limits of what we are learning from the study of their observable responses.

Sources of Information

For the last couple of decades, vertebrate ethologists have largely eschewed oversimplified models in which the responses of recipients are "released" by the advent of a signal. The releaser concept implies that a signal acts on responding individuals by evoking particular mental states that set in motion preordained behavior. This may account for some behavior during ontogeny and in other stark highly constrained cases. But most responding is based on more information than that provided just by a signal. As a single source of information, however pertinent, a signal is too limited. In practice, responding animals also attend to information from other sources that are contextual to the signal.

Some of these sources are things that occur when the signal occurs. A vocalizing animal can often be seen as well as heard, for instance, and its visible orientations, movements, and other actions are sources of information contextual to its vocal signalling. One way in which such concurrent sources of information can be experimentally controlled is to eliminate them, as Seyfarth and Cheney (this volume) did by hiding their playback speaker from the sight of the vervet monkeys they were studying. This procedure has its drawbacks (see subsequent paragraphs), but for questions of the sort Seyfarth and Cheney were testing, it is both convenient and useful.

Other crucial sources of information are not concurrent with the signal, however. These are the traces of earlier events (Smith, 1965, 1977). They are part of history and brought to events as memories by responding individuals. Experienced individuals may bring a great deal of information to bear on specific episodes in which a signal is perceived. They may, for instance, know what responses have usually been effective to the signals they most commonly encounter. They also know their companions' idiosyncratic predilections and can bias responding to account for these. They must have considerable knowledge of familiar events and probably organize this cognitively, as humans do, in "generalized event representations" (Nelson, 1981). Any adult ground squirrel, primate, or bird has encountered and responded to the signals of its repertoires many, many times. It would not be surprising if, for any signal, such an individual could predict (in some sense) a number of possible events and rank them by their relative probabilities of occurring and by the potential costs of predicting wrongly. It should do this whether the signal's referents are behavioral, external, or both and should then act on its predictions in ways that have usually been appropriate within its experience.

Information sources of this stored class, "historical" sources, often are not recognized in experiments that seek to control what is loosely called "context". As one result, the sources of the information used by individuals responding to a signal are not fully teased apart, and information from experience is misinterpreted as being supplied by the signal itself. More information thus gets attributed to a signal than the signal may supply. Yet to understand the cognitive bases of responding to signals we must understand just what information animals obtain from each source because they are free to choose which sources they attend to. To estimate incorrectly the information supplied by any source confounds attempts to use the behavior of communicating as a means of studying cognition.

In taking into account that responding to a signal is done in the context of information from various sources, however, we should not overestimate the complexity of information processing in any one event. Although everything in the world is informative, if perceived, no individual can deal with so much information. Animals must be selective both in what sources they attend to and in what information they accept as they assess events. Further, as studies of perception have shown, some stimulus must be selected to be focal amid the attended array of stimuli at any moment. (Signals must often become focal stimuli simply because such formalized acts performed by conspecific individuals are more likely to be pertinent to an individual than are many other sources of information; see Smith 1977: 207, 459.) Nonfocal contextual sources must be dealt with in accordance with the relevance of the information they contribute and to the extent to which an individual has the processing capacity to work with them.

Formulating Predictive Scenarios

If information is richly available from both concurrent and historical sources, how might animals use it in responding to signals? How do their minds work? For the most complex functioning, we can follow Griffin's suggestion and formulate a tentative proposal based on our own mental processes.

An individual animal presumably collects information and assesses its circumstances continuously. It must always seek to anticipate the unfolding of whatever events can be significant for it (Smith, 1977: 2, 193). To cope, the individual should compare the relevant information it gleans from various sources with expectations that it can base on both its current situation and its store of information. The results of these comparisons should be used in two ways. First, the individual should assess how closely its current circumstances fit the expectations upon which it has just been operating. From this evaluation it can fine-tune or alter its current grasp of the situation and the potential implications. Second, the individual should continue to generate further predictions and should use these both to guide its behavior moment-by-moment and to provide a perspective within which it can organize yet further information as it comes.

There is growing evidence that humans operate this way. We organize and store information about the usual progression of events, using cognitive structures that have been termed "scripts" (Schank & Abelson, 1977) or "memory organization packets" (Schank, 1982). This involves us in constructing "generalized event representations" for classes of events that have recurrent patterns, and we use these representations in particular episodes to predict development and to guide our behavior (Nelson, 1986). What I am calling a "predictive scenario" is simply a specific projection tailored to a particular episode and derived from generalized expectations about events with which that episode can be classed. Even very young children construct almost flawless generalized representations for familiar events suggesting that "such sequencing ability is an innate property of the human cognitive system" (Nelson, 1986, p. 241). If such children have this cognitive capacity, then animals of other species—all sharing the same need to anticipate unfolding events every waking moment of their lives—may have something very similar.

An individual's ability to respond flexibly to uncertain events is enhanced if competing predictions are generated simultaneously, to be chosen among as events develop. That is, whenever possible, an individual should entertain multiple working hypotheses about the nature and future course of its circumstances. As prediction emerges from among competing scenarios, an individual can assess a confidence level: Does available information support primarily one prediction, or is there important ambiguity and risk? Judgments about the significance of missing information must be made. Is it acceptable for certain information to be missing in the circumstances, or is its absence unexpected and troublesome? If prediction cannot be sufficiently confident, a judgment must be made whether to seek further information, go on to some other opportunity, or behave according to some preexisting program based on a class of scenarios. Among possible classes, a responding individual might invoke a "worst case" scenario and behave cautiously or preemptively unable to afford the possibility of dire consequences. Worst case scenarios must be especially likely to be chosen when events may involve predators or other severe dangers. More often, however, an individual might adopt a "typical case" scenario if experience suggests that it is encountering highly predictable kinds of events. Even with sparse information, responding might then be initiated on the basis of the most frequently encountered trend in a class of events (as suggested by Smith, 1985: 68). Such responses would usually be appropriate and would be altered as further information warranted.

The point of this speculation is to suggest a process in which information from numerous sources is actively integrated and compared with expectations that derive from both current and stored information. By following some simple rules that can be elaborated as experience is gained, an individual assesses and predicts events in preparing to respond to a signal. Experimental intervention at just one point in such a process might create problems with subsequent steps. For instance, minimizing the number of immediately available sources of information may violate expectations based on an individual's experience. If unable to obtain information that is usually present, a recipient of an experimentally presented signal may not make confident predictions. It may then search for information, fall back on a worst case scenario, or (if expecting little penalty) disregard the signal. On the other hand, experiments can also elicit responses that reveal stored information and show how animals organize it into a cognitive structure. By playing back screams of juveniles, for instance, Cheney and Seyfarth (1980) found that adult vervets associate different infants with the appropriate mothers and therefore understand at least basic behavioral relations of different mother-infant pairs.

Selecting Information

Among the implications of this process of context-dependent responding is that a recipient might respond to information only insofar as it fits the recipient's currently favored scenario. As in all perception, the responder would be selective in which sources of information it attends to, and it would discard some. Further, even for accepted sources, it might respond to only part of the information made available.

Each signal with behavioral referents provides information about the conditional performance of not one but several kinds of behavior, including kinds that are incompatible with one another. The several messages of any such signal thus provide recipients with opportunity for considerable flexibility in selecting the information they take.

Very simple examples include signals providing information about the conditional probabilities that a signaller will attack, vacillate or otherwise behave indecisively, or flee. Early in an encounter a recipient of such a signal may be interested primarily in whether it is about to be attacked or has some opportunity (dependent primarily upon the signaller's indecisive behavior) to negotiate. It might then largely disregard information about the probability of the signaller fleeing. As the encounter develops and the recipient becomes more experienced with its opponent, it might see that it can force at least a standoff. At this point it may become much more interested in information about the probability of the signaller withdrawing. Many other examples are easily imagined. One, with combinations of behavioral and external referents, is suggested in the section titled: The Referents of Animal Signalling. That example has the advantage of more than one individual responding to the same signal in the same event, making it possible to dissect the information underlying their different reactions.

Research on Responses

The responses animals make to signals, especially to playback of vocalizations, are currently one of the main foci of investigations of cognition. Although playback is a powerful procedure for influencing the scenarios animals form, it has some important limitations that are not widely recognized.

First, experimental control of sources of information contextual to the played-back sound is achieved largely by eliminating them (e.g., by hiding speakers). This forces animals to judge how to deal with the absence of information that would often be highly pertinent. Such circumstances may encourage wariness and may sometimes force individuals into extreme or atypical modes of responding.

Second, experimental control of much of the information stored in memory, historical context, is impractical.

Third, any signal that is presented provides several kinds of information, but the subjects respond only to some. Their responses provide few or no clues about what other information was made available. Responses made by recipients of signals often are not the most useful or definitive indicators of the referents of the signals and are too often used as such without adequate observation to determine the full correlates of signalling.

The study of responses to signals does reveal the outcome of the cognitive processes we would like to understand, because how animals respond depends on how they process the available information. Responses to playback of signals have also been used to reveal how animals have organized information they have accumulated through experience, for instance, information about who belongs with whom in the social order of their groups (e.g., Cheney & Seyfarth, 1980). However, the study of responses to signals as yet has revealed little that is readily interpreted about the processes themselves, although there are questions that can be addressed. For instance, Cheney and Seyfarth (in press) have used habituation to playback as an index of the extent to which vervets will classify together pairs of signals that have broadly similar external referents.

Summary

Studying how animals signal and respond to signalling may become an important way to gain insight into the workings of nonhuman minds, but the task will be difficult. It will involve learning (a) the extent to which individuals can alter their signalling to affect other individuals' responses, (b) what information is made available by signalling and by sources contextual to signals, and (c) how recipients of signals devise their responses.

Evidence for selective use of signalling is appearing in work with learned signals for things and abstract concepts and in studies of injury-feigning. Experiments with what are termed audience effects are also promising but limited as yet by the need to consider whether external or behavioral referents better account for effects other individuals are seen to have on a signaller.

To study cognitive processes, it is often necessary to be clear about the full complement of information that an animal makes available with a signal. Behavioral referents, however, have not been adequately dealt with in some of the literature on cognition. They have, for instance, been confounded with (or inappropriately reduced to) motivational or emotional states. This has led to an attempt to distinguish between symbolic and emotive use of animal signals even though having behavioral referents qualifies signals as symbols. Further, demonstrations that different signals do not represent different levels of "arousal" have sometimes been used to imply that the signals may shed little light on behavior. But signals make various kinds of behavior predictable, a contribution that is obscured when behavior is interpreted simply as affect or general arousal. There has been an important loss of perspective here which seriously clouds our understanding of the kinds of information that are made available by animal signals.

Behavioral and external referents correlate differently with signals, and this has been one source of the confusion. External referents such as predators or resources are present when a signal is performed. In contrast, the several behavioral referents of each signal are less obvious to observers because each occurs only conditionally; most are alternatives to one another, and some have relatively low probabilities of being performed.

Using experimentally elicited responses to study signals' referents has also led to some misinterpretation. Because animals respond to signals in context, and because contextual sources of information cannot be fully eliminated, this procedure risks overinterpreting a signal's role. (Even the experimental reduction of contextual sources of information concurrent with a signal creates a special circumstance in which stored sources of information gain proportionately heightened influence over responding.) Alternatively, the various kinds of information that a signal provides may be underestimated if it is not realized that a given response could be due to more than one kind of information. The basic procedure for interpreting the referents of signals should not usually be the study of how animals respond to signals but observation of what correlates signals have in the behavior and physical characteristics of signallers and in the external stimuli that may elicit signalling.

Context-dependent responding probably entails at least capacities to: (a) attend to numerous sources of information and select among them, (b) select among kinds of information and rank them into focal and contextual, (c) develop predictive scenarios based on both current and stored (historical) information, and (d) compare and select among competing scenarios as events develop. Further, animals should in some sense have expectations of what information *should* be present in kinds of events they have experienced, and they should use these expectations in generating typical case and worst case scenarios as the bases for adaptive temporizing when available information does not yet support firm prediction.

Although these cognitive operations may be feasible with a limited set of rules, they also allow for considerable elaboration and flexibility, and for the development of judgmental procedures. This suggests that some complexity of cognitive processing (in the collating and winnowing of information from various sources, in the storing of generalized event representations, and in the sequence of steps used to construct and alter predictive scenarios) is probably a characteristic that is widespread among diverse nonhuman animals.

Acknowledgments

I thank Don Griffin for being a friend and mentor for many years. For helpful comments on versions of the manuscript, I am indebted to D. Cheney, L. A. Draud, K. Kelley, A. Mostrom, C. Ristau, R. Seyfarth, A. M. Smith, R. Templeton, and especially D. Owings.

References

Cheney, D. L., and R. M. Seyfarth
1980 Vocal recognition in free-ranging vervet monkeys. *Animal Behavior, 28*, 362–367.

Cheney, D. L., and R. M. Seyfarth
In press Assessment of meaning and the detection of unreliable signals by vervet monkeys. *Animal Behavior.*

Collias, N. E.
1987 The vocal repertoire of the red junglefowl: A spectrographic classification and the code of communication. *Condor, 89*, 510–524.

Collias, N. E., and E. C. Collias
1967 A field study of the Red Jungle Fowl in north-central India. *Condor, 69*, 360–386.

Collias, N. E., and E. C. Collias
1985 Social behavior of unconfined Red Junglefowl. *Zoonooz*, 58(2), 4–10.

Dawkins, R.
1976 *The selfish gene.* New York: Oxford University Press.

Dittus, W. P.
1984 Toque macaque food calls: Semantic communication concerning food distribution in the environment. *Animal Behavior, 32*, 470–477.

Gouzoules, H., S. Gouzoules, and P. Marler
1985 External reference and affective signaling in mammalian vocal communication. In: G. Zivin (ed.), *The development of expressive behavior: Biology-environment interactions* (pp. 77–101). New York: Academic Press.

Gouzoules, S., H. Gouzoules, and P. Marler
1984 Rhesus monkey (*Macaca mulatto*) screams: Representational signalling in the recruitment of agonistic aid. *Animal Behavior, 32*, 182–193.

Green, S., and P. Marler
1979 The analysis of animal communication. In: P. Marler & J. G. Vandenbergh (eds.), *Handbook of behavioral neurobiology: Vol. 3. Social behavior and communication* (pp. 73–158). New York: Plenum Press.

Griffin, D. R.
1976 *The question of animal awareness: Evolutionary continuity of mental experience.* New York: Rockefeller University Press.

Griffin, D. R.
1985 Animal consciousness. *Neuroscience and Biobehavioral Reviews, 9*, 615–622.

Gyger, M., S. J. Karakashian, and P. Marler
1986 Avian alarm calling: Is there an audience effect? *Animal Behaviour, 34*, 1570–1572.

Hinde, R. A.
1985a Was ‘The Expression of the Emotions’ a misleading phrase? *Animal Behaviour, 33*, 985–992.

Hinde, R. A.
1985b Expression and negotiation. In: G. Zivin (ed.), *The development of expressive behavior: Biology-environment interactions* (pp. 103–116). New York: Academic Press.

Marler, P.
1984 Animal communication: Affect or cognition? In: K. R. Scherer & P. Ekman (eds.), *Approaches to emotion* (pp. 345–365). Hillsdale, NJ: Lawrence Erlbaum Associates.

Marler, P., A. Dufty, and R. Pickert
1986a Vocal communication in the domestic chicken: II. Is a sender sensitive to the presence and nature of a receiver? *Animal Behaviour, 34*, 194–198.

Marler, P., A. Dufty, and R. Pickert
1986b Vocal communication in the domestic chicken: I. Does a sender communicate information about the quality of a food referent to a receiver? *Animal Behaviour, 34*, 188–193.

Nelson, K.
1986 *Event knowledge: Structure and function in development.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Ogden, C. K. and I. A. Richards
1946 *The meaning of meaning* (8th ed.). New York: Harcourt, Brace & World.

Owings, D. H. and D. W. Leger
1980 Chatter vocalizations of California ground squirrels: Predator- and social-role specificity. *Zeitschrift für Tierpsychologie, 54*, 163–184.

Pepperberg, I.
1981 Functional vocalizations by an African grey parrot (*Psittacus erithacus*.) *Zeitschrift für Tierpsychologie, 55*, 139–160.

Pepperberg, I.
1987 Evidence for conceptual quantitative abilities in the African grey parrot: Labeling of cardinal sets. *Ethology, 75*, 37–61.

Schank, R. C.
1982 *Dynamic memory: A theory of reminding and learning in computers and people.* New York: Cambridge University Press.

Schank, R. C. and R. P. Abelson
1977 *Scripts, plans, goals and understanding: An enquiry into human knowledge structures.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Seyfarth, R.
1984 What the vocalizations of monkeys mean to humans, and what they mean to the monkeys themselves. In: R. Harré & V. Reynolds (eds.), *The meaning of primate signals* (pp. 43–56). New York: Cambridge University Press.

Seyfarth, R. M. and D. L. Cheney
1982 How monkeys see the world: A review of recent research on East African vervet monkeys. In: C. Snowdon, C. Brown, & M. Petersen (eds.), *Primate communication* (pp. 239–252). Cambridge: Cambridge University Press.

Seyfarth, R. M. and D. L. Cheney
1986 Vocal development in vervet monkeys. *Animal Behaviour, 34*, 1640–1658.

Seyfarth, R. M., D. L. Cheney, and P. Marler
1980a Vervet monkey alarm calls: Semantic communication in a free-ranging primate. *Animal Behaviour, 28*, 1070–1094.

Seyfarth, R. M., D. L. Cheney, and P. Marler
1980b Monkey responses to three different alarm calls: Evidence of predator classification and semantic communication. *Science, 210*, 801–803.

Smith, W. J.
1965 Message, meaning, and context in ethology. *American Naturalist, 99*, 405–409.

Smith, W. J.
1977 *The behavior of communicating.* Cambridge, MA: Harvard University Press.

Smith, W. J.
1981 Referents of animal communication. *Animal Behaviour, 29*, 1273–1275.

Smith, W. J.
1985 Consistency and change in communication. In: G. Zivin (ed.), *The development of expressive behavior: Biology-environment interactions* (pp. 51–76). New York: Academic Press.

Smith, W. J.
1986 Signaling behavior: Contributions of different repertoires. In: R. J. Schusterman, J. A. Thomas, & F. G. Wood (eds.), *Dolphin cognition and behavior: A comparative approach* (pp. 315–330). Hillsdale, NJ: Lawrence Erlbaum Associates.

Stokes, A. W. and H. W. Williams
1971 Courtship feeding in gallinaceous birds. *Auk, 88*, 543–559.

Problems in Cetacean and Other Mammalian Communication*

Gregory Bateson

The Communication of Preverbal Mammals

Of the Cetacea I have had little experience. I once dissected in the Cambridge Zoological Laboratories a specimen of *Phocoena* bought from the local fishmonger, and did not really encounter cetaceans again until this year, when I had an opportunity to meet Dr. Lilly's dolphins. I hope that my discussion of some of the questions that are in my mind as I approach these peculiar mammals will assist you in examining either these or related questions.

My previous work in the fields of anthropology, animal ethology, and psychiatric theory provides a theoretical framework for the transactional analysis of behavior. The premises of this theoretical position may be briefly summarized: (1) that a relationship between two (or more) organisms is, in fact, a sequence of S-R sequences (*i.e.*, of contexts in which proto-learning occurs); (2) that deutero-learning (*i.e.*, learning to learn) is, in fact, the acquiring of information about the contingency patterns of the contexts in which proto-learning occurs; and (3) that the "character" of the organism is the aggregate of its deutero-learning and therefore reflects the contextual patterns of past protolearning.[1]

These premises are essentially a hierarchic structuring of learning theory along lines related to Russell's Theory of Logical Types.[2] The premises, following the Theory of Types, are primarily appropriate for the analysis of *digital* communication. To what extent they may be applicable to analogic communi-

---

* From: Bateson, Gregory 1966. Problems in Cetacean and other mammalian communication. In: Norris, K. S. (ed.) Whales, Dolphins, and Porpoises, 569–578. California: University of California Press. © 1966. The Regents of the University of California. Reproduced with permission of University of California Press.

[1] J. Ruesch and G. Bateson, *Communication: The Social Matrix of Psychiatry*, New York, Norton, 1951.

[2] A. N. Whitehead and B. Russell, *Principia Mathematica*, London, Cambridge University Press, 1910.

cation or to systems that combine the digital with the analogic is problematic. I hope that the study of dolphin communication will throw light on these fundamental problems. The point is not either to discover that dolphins have complex language or to teach them English, but to close gaps in our theoretical knowledge of *communication* by studying a system that, whether rudimentary or complex, is almost certainly of a totally unfamiliar kind.

Let me start from the fact that the dolphin is a mammal. This fact has, of course, all sorts of implications for anatomy and physiology, but it is not with these that I am concerned. I am interested in his communication, in what is called his "behavior," looked at as an aggregate of data perceptible and *meaningful* to other members of the same species. It is meaningful, first, in the sense that it affects a recipient animal's behavior, and, second, in the sense that perceptible failure to achieve appropriate meaning in the first sense will affect the behavior of both animals. What I say to you may be totally ineffective, but my *ineffectiveness*, if perceptible, will affect both you and me. I stress this point because it must be remembered that in all relationships between man and some other animal, especially when that animal is a dolphin, a very large proportion of the behavior of both organisms is determined by this kind of ineffectiveness.

When I view the behavior of dolphins as communication, the mammalian label implies, for me, something very definite. Let me illustrate what I have in mind by an example from Benson Ginsburg's wolf pack in the Brookfield Zoo.

Among the Canidae, weaning is performed by the mother. When the puppy asks for milk, she presses down with her open mouth on the back of his neck, crushing him down to the ground. She does this repeatedly until he stops asking. This method is used by coyotes, dingoes, and the domestic dog. Among wolves the system is different. The puppies graduate smoothly from the nipple to regurgitated food. The pack comes back to the den with their bellies full. All regurgitate what they have got and all eat together. At some point the adults start to wean the puppies from these meals, using the method employed by the other Canidae; the adult crushes the puppy down by pressing its open mouth on the back of the puppy's neck. In the wolf this function is not confined to the mother, but is performed by adults of both sexes.

The pack leader of the Chicago pack is a magnificent male animal who endlessly patrols the acre of land to which the pack is confined. He moves with a beautiful trot that appears tireless, while the other eight or nine members of the pack spend most of their time dozing. When the females come in heat they usually proposition the leader, bumping against him with their rear ends. Usually, however, he does not respond, though he does act to prevent other males from getting the females. Last year one of these males succeeded in establishing coitus with a female. As in the other Canidae, the male wolf is locked in the female, unable to withdraw his penis, and this animal was helpless. Up rushed the pack leader. What did he do to the helpless male who dared to infringe the leader's prerogatives? Anthropomorphism would suggest that he would tear the helpless male to pieces. But no. The film shows that he pressed down the head of the offending male four times with his open jaws and then simply walked away.

What are the implications for research from this illustration? What the pack leader does is not describable, or only insufficiently described, in S-R terms. He does not "negatively reinforce" the other male's sexual activity. He asserts or affirms the nature of the relationship between himself and the other. If we were to translate the pack leader's action into words, the words would not be "Don't do that." Rather, they would translate the metaphoric action: "I am your senior adult male, you puppy!" What I am trying to say about wolves in particular, and about preverbal mammals in general, is that their discourse is primarily about the rules and the contingencies of relationship.

Let me offer a more familiar example to help bring home to you the generality of this view, which is by no means orthodox among ethologists. When your cat is trying to tell you to give her food, how does she do it? She has no word for food or for milk. What she does is to make movements and sounds that are characteristically those that a kitten makes to a mother cat. If we were to translate the cat's message into words, it would not be correct to say that she is crying "Milk!" Rather, she is saying something like "Mama!" Or, perhaps still more correctly, we should say that she is asserting "Dependency! Dependency!" The cat talks in terms of patterns and contingencies of relationship, and from this talk it is up to you to take a *deductive* step, guessing that it is milk that the cat wants. It is the necessity for this deductive step which marks the difference between preverbal mammalian communication and *both* the communication of bees and the languages of men.

What was extraordinary—the great new thing—in the evolution of human language was not the discovery of abstraction or generalization, but the discovery of how to be specific about something other than relationship. Indeed, this discovery, though it has been achieved, has scarcely affected the behavior even of human beings. If A says to B, "The plane is scheduled to leave at 6.30," B rarely accepts this remark as simply and solely a statement of fact about the plane. More often he devotes a few neurons to the question, "What does A's telling me this indicate for my relationship to A?" Our mammalian ancestry is very near the surface, despite recently acquired linguistic tricks.

Be that as it may, my first expectation in studying dolphin communication is that it will prove to have the general mammalian characteristic of being primarily about relationship. This premise is in itself perhaps sufficient to account for the sporadic development of large brains among mammals. We need not complain that, as elephants do not talk and whales invent no mousetraps, these creatures are not overtly intelligent. All that is needed is to suppose that large-brained creatures were, at some evolutionary stage, unwise enough to get into the game of relationship and that, once the species was caught in this game of interpreting its members' behavior toward one another as relevant to this complex and vital subject, there was survival value for those individuals who could play the game with greater ingenuity or greater wisdom. We may, then, reasonably expect to find a high complexity of communication about relationship among the Cetacea. Because they are mammals, we may expect that their communication will be about, and primarily in terms of, patterns and contingencies of relationship. Because they are social and large-brained, we may expect a high degree of complexity in their communication.

Methodological Considerations

The above hypothesis introduces very special difficulties into the problem of how to test what is called the "psychology" (*e.g.*, intelligence, ingenuity, discrimination, etc.) of individual animals. A simple discrimination experiment, such as has been run in the Lilly laboratories, and no doubt elsewhere, involves a series of steps: (1) The dolphin may or may not perceive a difference between the stimulus objects, X and Y. (2) The dolphin may or may not perceive that this difference is a cue to behavior. (3) The dolphin may or may not perceive that the behavior in question has a good or bad effect upon reinforcement, that is, that doing "right" is conditionally followed by fish. (4) The dolphin may or may not choose to do "right," even after he knows which is right. Success in the first three steps merely provides the dolphin with a further choice point. This extra degree of freedom must be the first focus of our investigations.

It must be our *first* focus for methodological reasons. Consider the arguments that are conventionally based upon experiments of this kind. We argue always from the later steps in the series to the earlier steps. We say, "If the animal was able to achieve step 2 in our experiment, then he must have been able to achieve step 1." If he could learn to behave in the way that would bring him the reward, then he must have had the necessary sensory acuity to discriminate between X and Y, and so on.

Precisely because we want to argue from observation of the animal's success in the later steps to conclusions about the more elementary steps, it becomes of prime importance to know whether the organism with which we are dealing is capable of step 4. If it is capable, then all arguments about steps 1 through 3 will be invalidated unless appropriate methods of controlling step 4 are built into the experimental design. Curiously enough, though human beings are fully capable of step 4, psychologists working with human subjects have been able to study steps 1 through 3 without taking special care to exclude the confusions introduced by this fact. If the human subject is "cooperative and sane," he usually responds to the testing situation by repressing most of his impulses to modify his behavior according to his personal view of his relationship to the experimenter. The words *cooperative* and *sane* imply a degree of consistency at the level of step 4. The psychologist operates by a sort of *petitio principii:* if the subject is cooperative and sane (*i.e.*, if the relational rules are fairly constant), the psychologist need not worry about changes in those rules.

The problem of method becomes entirely different when the subject is noncooperative, psychopathic, schizophrenic, a naughty child, or a dolphin. Perhaps the most fascinating characteristic of this animal is derived precisely from his ability to operate at this relatively high level, an ability that is still to be demonstrated.

Let me now consider for a moment the art of the animal trainer. From conversations with these highly skilled people—trainers of both dolphins and guide dogs—my impression is that the first requirement of a trainer is that he must be able to prevent the animal from exerting choice at the level of step 4. It must continually be made clear to the animal that, when he knows what is the right thing to do in a given context, that is the only thing he *can* do, and no nonsense about it. In other words, it is a primary condition of circus success that the animal shall abrogate the use of certain higher levels of his intelligence. The art of the hypnotist is similar.

There is a story told of Dr. Samuel Johnson. A silly lady made her dog perform tricks in his presence. The Doctor seemed unimpressed. The lady said, "But Dr. Johnson, you don't know how difficult it is for the dog." Dr. Johnson replied, "Difficult, madam? Would it were impossible!" *What* is amazing about circus tricks is that the animal can abrogate the use of so much of his intelligence and still have enough left to perform the trick. I regard the conscious intelligence as the greatest ornament of the human mind. But many authorities, from the Zen masters to Sigmund Freud, have stressed the ingenuity of the less conscious and perhaps more archaic level.

Communication about Relationship

As I said earlier, I expect dolphin communication to be of an almost totally unfamiliar kind. Let me expand on this point. As mammals, we are familiar with, though largely unconscious of, the habit of communicating about our relationships. Like other terrestrial mammals, we do most of our communicating on this subject by means of kinesic and paralinguistic signals, such as bodily movements, involuntary tensions of voluntary muscles, changes of facial expression, hesitations, shifts in tempo of speech or movement, overtones of the voice, and irregularities of respiration. If you want to know what the bark of a dog "means," you look at his lips, the pair on the back of his neck, his tail, and so on. These "expressive" parts of his body tell you at what object of the environment he is barking, and what patterns of relationship to that object he is likely to follow in the next few seconds. Above all, you look at his sense organs: his eyes, his ears, and his nose.

In all mammals, the organs of sense become also organs for the transmission of messages about relationship. A blind man makes us uncomfortable, not because he cannot see—that is his problem and we are only dimly aware of it—but because he does not transmit to us through the movement of his eyes the messages we expect and need so that we may know and be sure of the state of our relationship to him. We shall not know much about dolphin communication until we know what one dolphin can read in another's use, direction, volume, and pitch of echolocation.

Perhaps it is this lack in us which makes the communication of dolphins seem mysterious and opaque, but I suspect a more profound explanation. Adaptation to life in the ocean has stripped the whales of facial expression. They have no external ears to flap and few if any erectile hairs. Even the cervical vertebrae are fused into a solid block in many species, and evolution has streamlined the body, sacrificing the expressiveness of separate parts to the locomotion of the whole. Moreover, conditions of life in the sea are such that even if a dolphin had a mobile face, the details of his expression would be visible to other dolphins only at rather short range, even in the clearest waters.

It is reasonable, then, to suppose that in these animals vocalization has taken over the communicative functions that most animals perform by facial expression, wagging tails, clenched fists, supinated hands, flaring nostrils, and the like. We might say that the whale is the communicational opposite of the giraffe; it has no neck, but has a voice. This speculation alone would make the communication of dolphins a subject of great theoretical interest. It would be fascinating, for example, to know whether or not, in an evolutionary shift from kinesics to vocalization, the same general structure of categories is retained.

My own impression—and it is only an impression unsupported by testing—is that the hypothesis that dolphins have substituted paralinguistics for kinesics does not quite fit in with my experience when I listen to their sounds. We terrestrial mammals are familiar with paralinguistic communication; we use it ourselves in grunts and groans, laughter and sobbing, modulations of breath while speaking, and so on. Therefore we do not find the paralinguistic sounds of other mammals totally opaque. We learn rather easily to recognize in them certain kinds of greeting, pathos, rage, persuasion, and territoriality, though our guesses may often be wrong. But when we hear the sounds of dolphins we cannot even guess at their significance. I do not quite trust the hunch that would explain the sounds of dolphins as merely an elaboration of the paralinguistics of other mammals. (To argue thus from our inability is, however, weaker than to argue from what we can do.)

I personally do not believe that the dolphins have anything that a human linguist would call a "language." I do not think that any animal without hands would be stupid enough to arrive at so outlandish a mode of communication. To use a syntax and category system appropriate for the discussion of things that can be handled, while really discussing the patterns and contingencies of relationship, is fantastic. But that, I submit, is what is happening in this room. I stand here and talk while you listen and watch. I try to convince you, try to get you to see things my way, try to earn your respect, try to indicate my respect for you, challenge you, and so on. What is really taking place is a discussion of the patterns of our relationship, all according to the rules of a scientific conference about whales. So it is to be human.

I simply do not believe that dolphins have language in this sense. But I do believe that, like ourselves and other mammals, they are preoccupied with the patterns of their relationships. Let us call this discussion of patterns of relationship the μ-function of the message. After all, it was the cat who showed us the great importance of this function by her mewing. Preverbal mammals communicate about things, when they must, by using what are primarily μ-function signals. In contrast, human beings use language, which is primarily oriented toward things, to discuss relationships. The cat asks for milk by saying "Dependency," and I ask for your attention and perhaps respect by talking about whales. But we do not know that dolphins, in their communication, resemble either me or the cat. They may have a quite different system.

Analogic Versus Digital Communication

There is another side of the problem. How does it happen that the paralinguistics and kinesics of men from strange cultures, and even the paralinguistics of other terrestrial mammals, are at least partly intelligible to us, whereas the verbal languages of men from strange cultures seem to be totally opaque? In this respect it would seem that the vocalizations of the dolphin resemble human language rather than the kinesics or paralinguistics of terrestrial mammals.

We know, of course, why gestures and tones of voice are partly intelligible while foreign languages are unintelligible. It is because language is *digital* and kinesics and paralinguistics are *analogic*.[3] The essence of the matter is that in digital communication a number of purely conventional signs—1, 2, 3, X, Y, and so on—are pushed around according to rules called algorithms. The signs themselves have no simple connection (*e.g.*, correspondence of magnitude) with what they stand for. The numeral "5" is not bigger than the numeral "3." It is true that if we remove the crossbar from "7" we obtain the numeral "1"; but the crossbar does not, in any sense, stand for "6." A name usually has only a purely conventional or arbitrary connection with the *class* named. The numeral "5" is only the *name* of a magnitude. It is nonsense to ask if my telephone number is larger than yours, because the telephone exchange is a purely digital computer. It is not fed with magnitudes, but only with *names* of positions on a matrix.

In analogic communication, however, real magnitudes are used, and they correspond to real magnitudes in the subject of discourse. The linked range finder of a camera is a familiar example of an analogue computer. This device is fed with an angle that has real magnitude and is, in fact, the angle that the base of the range finder subtends at some point on the object to be photographed. This angle controls a cam that in turn moves the lens of the camera forward or back. The secret of the device lies in the shape of the cam, which is an analogic representation (*i.e*., a picture, a Cartesian graph) of the functional relationship between distance of object and distance of image.

Verbal language is almost (but not quite) purely digital. The word "big" is not bigger than the word "little"; and in general there is nothing in the pattern (*i.e.*, the system of interrelated magnitudes) in the word "table" which would correspond to the system of interrelated magnitudes in the object denoted. On the other hand, in kinesic and paralinguistic communication, the magnitude of the gesture, the loudness of the voice, the length of the pause, the tension of the muscle, and so forth—these magnitudes commonly correspond (directly or inversely) to magnitudes in the relationship that is the subject of discourse. The pattern of action in the communication of the wolf pack leader is immediately

---

[3] The difference between digital and analogic modes of communication may perhaps be made clear by thinking of an English-speaking mathematician confronted with a paper by a Japanese colleague. He gazes uncomprehendingly at the Japanese ideographs, but he is able partly to understand the Cartesian graphs in the Japanese publication. The ideographs, though they may originally have been analogic pictures, are now purely digital; the Cartesian graphs are analogic.

intelligible when we have data about the weaning practices of the animal, for the weaning practices are themselves analogic kinesic signals.

It is logical, then, to consider the hypothesis that the vocalization of dolphins may be a *digital* expression of μ-functions. It is this possibility that I especially have in mind in saying that this communication may be of an, almost totally unfamiliar kind. Man, it is true, has a few words for μ-functions, words like "love," "respect," "dependency," and so on. But these words function poorly in the actual discussion of relationship between participants in the relationship. If you say to a girl, "I love you," she is likely to pay more attention to the accompanying kinesics and paralinguistics than to the words themselves.

We humans become very uncomfortable when somebody starts to interpret our postures and gestures by translating them into words about relationship. We much prefer that our messages on this subject remain analogic, unconscious, and involuntary. We tend to distrust the man who can simulate messages about relationship. We therefore have no idea what it is like to be a species with even a very simple and rudimentary *digital* system whose primary subject matter would be μ-functions. This system is something we terrestrial mammals cannot imagine and for which we have no empathy.

Research Plans

The most speculative part of my paper is the discussion of plans for the testing and amplification of such a body of hypotheses. I shall be guided by the following heuristic assumptions:

(1) The epistemology in whose terms the hypotheses are constructed is itself not subject to testing. Derived from Whitehead and Russell,[4] it serves to guide our work. Should the work prove rewarding, the success will be only a weak verification of the epistemology.

(2) We do not even know what a primitive digital system for the discussion of patterns of relationship might look like, but we can guess that it would not look like a "thing" language. (It might, more probably, resemble music.) I shall therefore not expect the techniques for cracking human linguistic codes to be immediately applicable to the vocalization of dolphins.

(3) The first requirement, then, is to identify and to classify the varieties and the components of relationship existing among the animals through detailed ethological study of their actions, interactions, and social organization. The elements of which these patterns are built are doubtless still present in the

---

[4] Whitehead and Russell, *op. cit.*

kinesics and actions of the species. We therefore begin with a listing of the kinesic signals of individual dolphins, and then try to relate them to the contexts in which they are used.

(4) No doubt, just as the pack leader's behavior tells us that "dominance" among wolves is metaphorically related to weaning, so also the dolphins will tell us their kinesic metaphors for "dominance," "dependency," and other μ-functions. Gradually this system of signals will fit together piece by piece to form a picture of the varieties of relationship existing even among animals arbitrarily confined together in a tank.

(5) As we begin to understand the metaphor system of the dolphin, it will become possible to recognize and classify the contexts of his vocalization. At this point the statistical techniques for cracking codes may conceivably become useful.

(6) The assumptions regarding the hierarchic structure of the learning process—upon which this whole paper is based—provide the basis for various kinds of experimentation. The contexts of proto-learning may be variously constructed with a view to observing in what types of contexts certain types of learning most readily occur. We shall pay special attention to those contexts that involve either relationships between two or more animals and one person, or relationships between two or more people and one animal. Such contexts are miniature models of social organization within which the animal may be expected to show characteristic behaviors and to make characteristic attempts to modify the context (*i.e.*, to manipulate the humans).

Metalogue: What is an Instinct?[*]

Gregory Bateson

Daughter: Daddy, what is an instinct?
Father: An instinct, my dear, is an explanatory principle.
Daughter: But what does it explain?
Father: Anything—almost anything at all. Anything you want it to explain.
Daughter: Don't be silly. It doesn't explain gravity.
Father: No. But that is because nobody wants 'instinct' to explain gravity. If they did, it would explain it. We could simply say that the moon has an instinct whose strength varies inversely as the square of the distance…
Daughter: But that's nonsense, Daddy.
Father: Yes, surely. But it was you who mentioned 'instinct', not I.
Daughter: All right—but then what does explain gravity?
Father: Nothing, my dear, because gravity is an explanatory principle.
Daughter: Oh.

Daughter: Do you mean that you cannot use one explanatory principle to explain another? Never?
Father: Hm … hardly ever. That is what Newton meant when he said, "*hypotheses non fingo*".
Daughter: And what does that mean? Please.
Father: Well, you know what 'hypotheses' are. Any statement linking together two descriptive statements is an hypothesis. If you say that there was a full moon on February 1st and another on March 1st; and then you link these two observations together in any way, the statement which links them is an hypothesis.
Daughter: Yes—and I know what *non* means. But what's *fingo*?
Father: Well—*fingo* is a late Latin word for 'make'. It forms a verbal noun *fictio* from which we get the word 'fiction'.

---

[*] From: Bateson, Gregory 1969. What is instinct. In: Thomas A. Sebeok, Alexandra Ramsay (eds.), *Approaches to animal communication*. (*Approaches to Semiotics* 1), 11–30. The Hague: Mouton.

Daughter: Daddy, do you mean that Sir Isaac Newton thought that all hypotheses were just MADE UP like stories?
Father: Yes—precisely that.
Daughter: But didn't he discover gravity? With the apple?
Father: No, dear. He invented it.
Daughter: Oh.
Daughter: Daddy, who invented instinct?

Father: I don't know. Probably biblical.
Daughter: But if the idea of gravity links together two descriptive statements, it must be an hypothesis.
Father: That's right.
Daughter: Then Newton did *fingo* an hypothesis after all.
Father: Yes—indeed he did. He was a very great scientist.
Daughter: Oh.

Daughter: Daddy, is an explanatory principle the same thing as an hypothesis?
Father: Nearly, but not quite. You see, an hypothesis tries to explain some particular something but an explanatory principle—like 'gravity' or 'instinct'—really explains nothing. It's a sort of conventional agreement between scientists to stop trying to explain things at a certain point.
Daughter: Then is that what Newton meant? If 'gravity' explains nothing but is only a sort of full stop at the end of a line of explanation, then inventing gravity was not the same as inventing an hypothesis, and he could say he did not *fingo* any hypotheses.
Father: That's right. There's no explanation of an explanatory principle. It's like a black box.
Daughter: Oh.

Daughter: Daddy, what's a black box?
Father: A 'black box' is a conventional agreement between scientists to stop trying to explain things at a certain point. I guess it's usually a temporary agreement.
Daughter: But that doesn't sound like a black box.
Father: No—but that's what it's called. Things often don't sound like their names.
Daughter: No.

Father: It’s a word that comes from the engineers. When they draw a diagram of a complicated machine, they use a sort of shorthand. Instead of drawing all the details, they put a box to stand for a whole bunch of parts and label the box with what that bunch of parts is supposed to DO.
Daughter: So a ‘black box’ is a label for what a bunch of things are supposed to do…
Father: That’s right. But it’s not an explanation of HOW the bunch works.
Daughter: And gravity?
Father: Is a label for what gravity is supposed to do. It’s not an explanation of how it does it.
Daughter: Oh.

Daughter: Daddy, what is an instinct?
Father: It’s a label for what a certain black box is supposed to do.
Daughter: But what’s it supposed to do?
Father: Hm. That is a very difficult question…
Daughter: Go on.
Father: Well. It’s supposed to control—partly control—what an organism does.
Daughter: Do plants have instincts?
Father: No. If a botanist used the word ‘instinct’, when talking about plants, he would be accused of zoomorphism.
Daughter: Is that bad?
Father: Yes. Very bad for botanists. For a botanist to be guilty of zoomorphism is as bad as for a zoologist to be guilty of anthropomorphism. Very bad, indeed.
Daughter: Oh. I see.

Daughter: What did you mean by ‘partly control’?
Father: Well. If an animal falls down a cliff, its falling is controlled by gravity. But if it wiggles while falling, that might be due to instinct.
Daughter: Self-preservative instinct?
Father: I suppose so.
Daughter: What is a self, daddy? Does a dog know it has a self?
Father: I don’t know. But if the dog does know it has a self, and it wiggles in order to preserve that self, then its wiggling is RATIONAL, not instinctive.
Daughter: Oh. Then a ‘self-preservative instinct’ is a contradiction.
Father: Well, it’s a sort of halfway house on the road to anthropomorphism.

Daughter: Oh. That's bad.
Father: But the dog might KNOW it had a self and not know that that self should be preserved. lt would then be rational to NOT wiggle. So if the dog still wiggles, this would be instinctive. But if it LEARNED to wiggle, then it would not be instinctive.
Daughter: Oh.

Daughter: What would not be instinctive, daddy? The learning or the wiggling?
Father: No—just the wiggling.
Daughter: And the LEARNING would be instinctive?
Father: Well … yes. Unless the dog had to LEARN to learn.
Daughter: Oh.

Daughter: But, daddy, what is instinct supposed to explain?
Father: I keep trying to avoid that question. You see, instincts were invented before anybody knew anything about genetics, and most of modern genetics was discovered before anybody knew anything about communication theory. So it is doubly difficult to translate 'instinct' into modern terms and ideas.
Daughter: Yes, go on.
Father: Well, you know that in the chromosomes, there are genes; and that the genes are some sort of messages which have to do with how the organism develops and with how it behaves.
Daughter: Is developing different from behaving, Daddy? What's the difference? And which is learning? Is it 'developing' or 'behaving'?
Father: No! No! Not so fast. Let's avoid those questions by putting developing-learning-behavior all together in one basket. A single spectrum of phenomena. Now let's try to say how instinct contributes to explaining this spectrum.
Daughter: But is it a spectrum?
Father: No—that's only a loose way of talking.
Daughter: Oh.

Daughter: But isn't instinct all on the behavior end of that 'spectrum'? And isn't learning all determined by environment and not chromosomes?
Father: Let's get this clear—that there is no behavior and no anatomy and no learning in the chromosomes themselves.
Daughter: Don't they have their own anatomy?

Father: Yes, of course. And their own physiology. But the anatomy and physiology of the genes and chromosomes is NOT the anatomy and physiology of the whole animal.
Daughter: Of course not.
Father: But it is ABOUT the anatomy and physiology of the whole animal.
Daughter: Anatomy ABOUT anatomy?
Father: Yes, just as letters and words have their own forms and shapes and those shapes are parts of words or sentences and so on —which may be ABOUT anything.
Daughter: Oh.

Daughter: Daddy, is the anatomy of the genes and chromosomes about the anatomy of the whole animal? And the physiology of the genes and chromosomes about the physiology of the whole animal?
Father: No, no. There is no reason to expect that. It's not like that. Anatomy and physiology are not separate in that way.
Daughter: Daddy, are you going to put anatomy and physiology together in one basket, like you did developing-learning-behavior?
Father: Yes. Certainly.
Daughter: Oh.

Daughter: The SAME basket?
Father: Why not? I think DEVELOPING is right in the middle of that basket. Right smack in the middle.
Daughter: Oh.

Daughter: If chromosomes and genes have anatomy and physiology, they must have development.
Father: Yes. That follows.
Daughter: Do you think their development could be ABOUT the development of the whole organism?
Father: I don't even know what that question would mean.
Daughter: I do. It means that the chromosomes and genes would be changing or developing somehow while the baby is developing, and the changes in the chromosomes would be ABOUT the changes in the baby. Controlling them or PARTLY controlling them.
Father: No. I don't think so.
Daughter: Oh.

Daughter: Do chromosomes LEARN?
Father: I don’t know.
Daughter: They do sound rather like black boxes.
Father: Yes, but if chromosomes or genes can learn, then they are much more complicated black boxes than anybody at present believes. Scientists are always assuming or hoping that things are simple, and then discovering that they are not.
Daughter: Yes, Daddy.

Daughter: Daddy, is that an instinct?
Father: Is what an instinct?
Daughter: Assuming that things are simple.
Father: No. Of course not. Scientists have to be taught to do that.
Daughter: But I thought no organism could be taught to be wrong EVERY time.
Father: Young lady, you are being disrespectful and wrong. In the first place, scientists are not wrong every time they assume that things are simple. Quite often they are right or partly right and still more often, they think they are right and tell each other so. And that is enough reinforcement. And, anyhow you are wrong in saying that no organism can be taught to be wrong every time.

Daughter: When people say that something is ‘instinctive’ are they trying to make things simple?
Father: Yes, indeed.
Daughter: And are they wrong?
Father: I don’t know. It depends on what they mean.
Daughter: Oh.

Daughter: WHEN do they do it?
Father: Yes, that’s a better way of asking the question. They do it when they see a creature do something, and they are sure: first, that the creature did not learn how to do that something and, second, that the creature is too stupid to understand why it should do that.
Daughter: Any other time?
Father: Yes. When they see that all members of the species do the same things under the same circumstances; and when they see the animal repeating the same action even when the circumstances are changed so that the action fails.
Daughter: So there are four ways of knowing that it’s instinctive.

Father: No. Four conditions under which scientists talk about instinct.
Daughter: But what if one condition isn't there? An instinct sounds rather like a habit or a custom.
Father: Best habits are learned.
Daughter: Yes.

Daughter: Are habits always TWICE learned?
Father: What do you mean?
Daughter: I mean—when I learn a set of chords on the guitar, first I learn them or find them; and then later when I practice, I get the HABIT of playing them that way. And sometimes I get bad habits.
Father: Learning to be wrong EVERY time?
Daughter: Oh—all right. But what about that twice over business? Would BOTH parts of learning be not there if guitar playing were instinctive?
Father: Yes. If both parts of learning were clearly not there, scientists might say that guitar playing is instinctive.
Daughter: But what if only one part of learning was missing?
Father: Then, logically, the missing part could be explained by instinct.
Daughter: Could EITHER part be missing?
Father: I don't know. I don't think anybody knows.
Daughter: Oh.

Daughter: Do birds PRACTICE their songs?
Father: Yes. Some birds are said to practice.
Daughter: I guess instinct gives them the first part of singing, but they have to work on the second part.
Father: Perhaps.

Daughter: Could PRACTICING be instinctive?
Father: I suppose it could be—but I am not sure what the word 'instinct' is coming to mean in this conversation.
Daughter: It's an explanatory principle, daddy, just like you said…
Daughter: There's one thing I don't understand.
Father: Yes?
Daughter: Is there a whole lot of instinct? Or are there lots of instincts?
Father: Yes, That's a good question, and scientists have talked a great deal about it, making lists of separate instincts and then lumping them together again.
Daughter: But what's the answer?

Father: Well. It's not quite clear. But one thing is certain: That explanatory principles must be not multiplied beyond necessity.

Daughter: And that means? Please?

Father: It's the idea behind monotheism—that the idea of one big God is to be preferred to the idea of two little gods.

Daughter: Is God an explanatory principle?

Father: Oh, yes—a very big one. You shouldn't use two black boxes—or two instincts—to explain what one black box would explain…

Daughter: If it were big enough.

Father: No. It means…

Daughter: Are there big instincts and little instincts?

Father: Well—as a matter of fact, scientists do talk as if there were. But they call the little instincts by other names—'reflexes', 'innate releasing mechanisms', 'fixed action patterns', and so on.

Daughter: I see—like having one big God to explain the universe and lots of little 'imps' or 'goblins' to explain the small things that happen.

Father: Well, yes. Rather like that.

Daughter: But, daddy, how do they lump things together to make the big instincts?

Father: Well, for example, they don't say that the dog has one instinct which makes it wiggle when it falls down the cliff and another which makes it run away from fire.

Daughter: You mean those would both be explained by a self-preservative instinct?

Father: Something like that. Yes.

Daughter: But if you put those different acts together under one instinct, then you cannot get away from saying that the dog has the use of the notion of 'self'.

Father: No, perhaps not.

Daughter: What would you do about the instinct for the song and the instinct for practicing the song?

Father: Well—depending on what the song is used for. Both song and practice might be under a territorial instinct or a sexual instinct.

Daughter: I wouldn't put them together.

Father: No?

Daughter: Because what if the bird also practiced picking up seed or something. You'd have to multiply the instincts—what is it?—beyond necessity.

Father: What do you mean?

Daughter: I mean a food-getting instinct to explain the practicing picking up seed, and a territory instinct for practicing song. Why not have a PRACTICING instinct for both? That saves one black box.
Father: But then you would throw away the idea of lumping together under the same instinct actions which have the same purpose.
Daughter: Yes—because if the practicing is for a purpose—I mean, if the BIRD has a purpose—then the practicing is RATIONAL and not instinctive. Didn't you say something like that?
Father: Yes, I did say something like that.

Daughter: Could we do without the idea of 'instinct'?
Father: How would you explain things then?
Daughter: Well. I'd just look at the little things: When something goes 'pop', the dog jumps. When the ground is not under his feet, he wiggles. And so on.
Father: You mean—all the imps but no gods?
Daughter: Yes something like that.
Father: Well. There are scientists who try to talk that way, and it's becoming quite fashionable. They say it is more OBJECTIVE.
Daughter: And is it?
Father: Oh, yes.

Daughter: What does 'objective' mean?
Father: Well. It means that you look very hard at those things which you choose to look at.
Daughter: That sounds right. But how do the objective people choose which things they will be objective about?

Father: Well. They choose those things about which it is easy to be objective.
Daughter: You mean easy for them?
Father: Yes.
Daughter: But how do they KNOW that those are the easy things?
Father: I suppose they try different things and find out by experience.
Daughter: So it's a subjective choice?
Father: Oh, yes. All experience is subjective.
Daughter: But it's HUMAN and subjective. They decide which bits of animal behavior to be objective about by consulting human subjective experience. Didn't you say that anthropomorphism is a bad thing?
Father: Yes—but they do try to be not human.

Daughter: Which things do they leave out?
Father: What do you mean?
Daughter: I mean—subjective experience shows them which things it is easy to be objective about. So, they go and study those things. But which things does their experience show are difficult? So that they avoid those things. Which are the things they avoid?
Father: Well, you mentioned earlier something called 'practice'. That's a difficult thing to be objective about. And there are other things that are difficult in the same sort of way. PLAY, for example. And EXPLORATION. It's difficult to be objective about whether a rat is REALLY exploring or REALLY playing. So they don't investigate those things. And then there's love. And, of course, hate.
Daughter: I see. Those are the sorts of things that I wanted to invent separate instincts for.
Father: Yes—those things. And don't forget humor.

Daughter: Daddy—are animals objective?
Father: I don't know—probably not. I don't think they are subjective either. I don't think they are split that way.

Daughter: Isn't it true that people have a special difficulty about being objective about the more animal parts of their nature?
Father: I guess so. Anyhow Freud said so, and I think he was right. Why do you ask?
Daughter: Because, oh dear, those poor people. They try to study animals. And they specialize in those things that they can study objectively. And they can only be objective about those things in which they themselves are least like animals. It must be difficult for them.
Father: No—that does not necessarily follow. It is still possible for people to be objective about SOME things in their animal nature. You haven't shown that the whole of animal behavior is within the set of things that people cannot be objective about.
Daughter: No?

Daughter: What are the really big differences between people and animals?
Father: Well—intellect, language, tools. Things like that.
Daughter: And it is easy for people to be intellectually objective in language and about tools?
Father: That's right.

Daughter: But that must mean that in people there is a whole set of ideas or whatnot which are all tied together. A sort of second creature within the whole person, and that second creature must have a quite different way of thinking about everything. An objective way.

Father: Yes. The royal road to consciousness and objectivity is through language and tools.

Daughter: But what happens when this creature looks at all those parts of the person about which it is difficult for people to be objective? Does it just look? Or does it meddle?

Father: It meddles.

Daughter: And what happens?

Father: That's a very terrible question.

Daughter: Go on. If we are going to study animals, we must face that question.

Father: Well … The poets and artists know the answer better than the scientists. Let me read you a piece:

> '*Thought* chang'd the infinite to a serpent, that which pitieth
> To a devouring flame; and man fled from its face and hid
> In forests of night: then all the eternal forests were divided
> Into earths rolling in circles of space, that like an ocean rush'd
> And overwhelmed all except this finite wall of flesh.
> Then was the serpent temple form'd, image of infinite
> Shut up in finite revolutions; and man became an Angel,
> Heaven a mighty circle turning, God a tyrant crown'd.'
>
> (Blake, W., 1794)[1]

Daughter: I don't understand it. It sounds terrible, but what does it mean?

Father: Well. It's not an objective statement, because it is talking about the EFFECT OF objectivity—what the poet calls here 'thought' upon the whole person or the whole of life. 'Thought' should remain a part of the whole but instead spreads itself and meddles with the rest.

Daughter: Go on.

Father: Well. It slices everything to bits.

Daughter: I don't understand.

Father: Well, the first slice is between the objective thing and the rest. And then INSIDE the creature that's made in the model of intellect, lan-

---

[1] Blake, W., 1794, Europe a Prophecy, printed and published by the author.

guage, and tools, it is natural that PURPOSE will evolve. Tools are for purposes and anything which blocks purpose is a hindrance. The world of the objective creature gets split into ‘helpful’ things and hindering’ things.

Daughter: Yes. I see that.

Father: All right. Then the creature applies that split to the world of the whole person, and ‘helpful’ and ‘hindering’ become Good and Evil, and the world is then split between God and the Serpent. And after that, more and more splits follow because the intellect is always classifying and dividing things up.

Daughter: Multiplying explanatory principles beyond necessity?

Father: That’s right.

Daughter: So, inevitably, when the objective creature looks at animals, it splits things up and makes the animals look like human beings AFTER their intellects have invaded their souls.

Father: Exactly. It’s a sort of inhuman anthropomorphism.

Daughter: And that is why the objective people study all the little imps instead of the larger things?

Father: Yes. It’s called S-R psychology. It’s easy to be objective about sex but not about love.

Daughter: Daddy, we’ve talked about two ways of studying animals —the big instinct way and the S-R way, and neither way seemed very sound. What do we do now?

Father: I don’t know.

Daughter: Didn’t you say that the royal road to objectivity and consciousness is language and tools? What’s the royal road to the other half?

Father: Freud said dreams.

Daughter: Oh.

Daughter: What are dreams? How are they put together?

Father: Well—dreams are bits and pieces of the stuff of which we are made. The non-objective stuff.

Daughter: But how are they put together?

Father: Look. Aren’t we getting rather far from the question of explaining animal behavior?

Daughter: I don’t know, but I don’t think so. It looks as if we are going to be anthropomorphic in one way or another, whatever we do. And it is obviously wrong to build our anthropomorphism on that side of man's nature in which he is most unlike the animals. So let's try the other side. You say dreams are the royal road to the other side. So…

Father: I didn't. Freud said it. Or something like it.

Daughter: All right. But how are dreams put together?

Father: Do you mean how are two dreams related to each other?

Daughter: No. Because, as you said, they are only bits and pieces. What I mean is: How is a dream put together inside itself? Could animal behavior be put together in the same sort of way?

Father: I don't know where to begin.

Daughter: Well. Do dreams go by opposites?

Father: O Lord! The folk old idea. No. They don't predict the future. Dreams are sort of suspended in time. They don't have any tenses.

Daughter: But if a person is afraid of something which he knows will happen tomorrow, he might dream about it tonight?

Father: Certainly. Or about something in his past. Or about both past and present. But the dream contains no label to tell him what it is 'about' in this sense. It just is.

Daughter: Do you mean it's as if the dream had no title page?

Father: Yes. It's like an old manuscript or a letter that has lost its beginning and end, and the historian has to guess what it's all about and who wrote it and when—from what's INSIDE it.

Daughter: Then we're going to have to be objective, too?

Father: Yes indeed. But we know that we have to be careful about it. We have to watch that we don't force the concepts of the creature that deals in language and tools upon the dream material.

Daughter: How do you mean?

Father: Well. For example: if dreams somehow have not tenses and are somehow suspended in time, then it would be forcing the wrong sort of objectivity to say that a dream 'predicts' something. And equally wrong to say it is a statement about the past. It's not history.

Daughter: Only propaganda?

Father: What do you mean?

Daughter: I mean—is it like the sort of stories that propagandists write which they say are history but which are really only fables?

Father: All right. Yes. Dreams are in many ways like myths and fables. But not consciously made up by a propagandist. Not planned.

Daughter: Does a dream always have a moral?

Father: I don’t know about ALWAYS. But OFTEN, yes. But the moral is not stated in the dream. The psychoanalyst tries to get the patient to find the moral. Really the whole dream is the moral.

Daughter: What does that mean?

Father: I don’t quite know.

Daughter: Well. Do dreams go by opposites? Is the moral the opposite of what the dream seems to say?

Father: Oh yes. Often. Dreams often have an ironic or sarcastic twist. A sort of *reductio ad absurdum.*

Daughter: For example?

Father: All right. A friend of mine was a fighter pilot in World War II. After the war he became a psychologist and had to sit for his Ph.D. oral exam. He began to be terrified of the oral, but, the night before the exam, he had a nightmare in which he experienced again being in a plane which had been shot down. Next day he went into the examination without fear.

Daughter: Why?

Father: Because it was silly for a fighter pilot to be afraid of a bunch of university professors who couldn’t REALLY shoot him down.

Daughter: But how did he know that? The dream could have been telling him that the professors WOULD shoot him down. How did he know it was ironic?

Father: Hm. The answer is he didn’t know. The dream doesn’t have a label on it to say it is ironic. And when people are being ironic in waking conversation they often don’t tell you they are being ironic.

Daughter: No. That’s true. I always think it’s sort of cruel.

Father: Yes. It often is.

Daughter: Daddy, are animals ever ironic or sarcastic?

Father: No. I guess not. But I am not sure that those are quite the words we should use. ‘Ironic’ and ‘sarcastic’ are words for the analysis of message material in language. And animals don’t have language. It’s perhaps part of the wrong sort of objectivity.

Daughter: All right. Then do animals deal in opposites?

Father: Well, yes. As a matter of fact, they do. But I’m not sure it’s the same thing…

Daughter: Go on. How do they? And when?

Father: Well. You know how a puppy lies on his back and presents his belly to a bigger dog. That's sort of inviting the bigger dog to attack. But it works in the opposite way. It stops the bigger dog from attacking.

Daughter: Yes. I see. It is a sort of use of opposites. But do they KNOW that?

Father: You mean does the big dog know that the little dog is saying the opposite of what he means? And does the little dog know that that is the way to stop the big dog.

Daughter: Yes.

Father: I don't know. I sometimes think the little dog knows a little more about it than the big dog. Anyhow, the little dog does not give any signals to show that he knows. He obviously couldn't do that.

Daughter: Then it's like the dreams. There's no label to say that the dream is dealing in opposites.

Father: That's right.

Daughter: I think we're getting somewhere. Dreams deal in opposites, and animals deal in opposites, and neither carries labels to say when they are dealing in opposites.

Father: Hm.

Daughter: Why do animals fight?

Father: Oh, for many reasons. Territory, sex, food…

Daughter: Daddy, you're talking like instinct theory. I thought we agreed not to do that.

Father: All right. But what sort of an answer do you want to the question, why animals fight?

Daughter: Well. Do they deal in opposites?

Father: Oh. Yes. A lot of fighting ends up in some sort of peace-making. And certainly playful fighting is partly a way of affirming friendship. Or discovering or rediscovering friendship.

Daughter: I thought so…

Daughter: But why are the labels missing? Is it for the same reason in both animals and dreams?

Father: I don't know. But, you know, dreams do not always deal in opposites.

Daughter: No—of course not—nor do animals.

Father: All right then.

Daughter: Let's go back to that dream. Its total effect on the man was the same as if somebody had said to him, "You in a fighter plane" is not equal to "you in an oral exam".

Father: Yes. But the dream didn't spell that out. It only says, "You in a fighter plane". It leaves out the 'not', and it leaves out the instruction to compare the dream with something else and it doesn't say what he should compare it with.

Daughter: All right. Let's take the 'not' first. Is there any 'not' in animal behavior?

Father: How could there be?

Daughter: I mean can an animal say by its actions, "I will not bite you"?

Father: Well, to begin with. Communication by actions cannot possibly have tenses. They are only possible in language.

Daughter: Didn't you say that dreams have no tenses?

Father: Hm. Yes, I did.

Daughter: OK. But what about 'not'. Can the animal say, "I am not biting you".

Father: That still has a tense in it. But never mind. If the animal IS not biting the other, he's not biting it, and that's it.

Daughter: But he might be not doing all sorts of other things, sleeping, eating, running, and so on. How can he say, "It's biting that I'm not doing"?

Father: He can only do that if biting has somehow been mentioned.

Daughter: Do you mean that he could say, "I am not biting you" by first showing his fangs and THEN not biting.

Father: Yes. Something like that.

Daughter: But what about TWO animals? They'd both have to show their fangs.

Father: Yes.

Daughter: And, it seems to me, they might misunderstand each other, and get into a fight.

Father: Yes. There is always that danger when you deal in opposites and do not or cannot say what you are doing, especially when you do not KNOW what you are doing.

Daughter: But the animals would know that they bared their fangs in order to say, "I won't bite you".

Father: I doubt whether they would know. Certainly neither animal knows it about the other. The dreamer doesn't know at the beginning of the dream how the dream is going to end.

Daughter: Then it's a sort of experiment…

Father: Yes.

Daughter: So they might get into a fight in order to find out whether fighting was what they had to do.

Father: Yes—but I'd rather put it less purposively—that the fight shows them what sort of relationship they have, after it. It's not planned.

Daughter: Then the 'not' is really not there when the animals show their fangs?

Father: I guess not. Or often not. Perhaps old friends might engage in playful fighting and know at the beginning what they are doing.

Daughter: All right. Then the 'not' is absent in animal behavior because 'not' is part of verbal language, and there cannot be any action signal for 'not'. And because there is no 'not', the only way to agree on a negative is to act out the whole *reductio ad absurdum.* You have to act out the battle to prove it isn't one, and then you have to act out the submission to prove that the other won't eat you.

Father: Yes.

Daughter: Did the animals have to think that out?

Father: No. Because it's all NECESSARILY true. And that which is necessarily true will govern what you do regardless of whether you know that it is necessarily true. If you put two apples with three apples you will get five apples—even though you cannot count. It's another way of 'explaining' things.

Daughter: Oh.

Daughter: But, then, why does the dream leave out the 'not'?

Father: I think really for a rather similar reason. Dreams are mostly made of images and feelings, and if you are going to communicate in images and feelings and such, you again are governed by the fact that there is no image for 'not'.

Daughter: But you could dream of a 'Stop' sign with a line through it, which would mean 'No Stopping'.

Father: Yes. But that's halfway towards language. And the deleting line isn't the word 'not'. It's the word 'don't'. 'Don't' can be conveyed in action language—if the OTHER person makes a move to mention what you want to forbid. You can even dream in words, and the word 'not' might be among them. But I doubt if you can dream a 'not' which is about the dream. I mean a 'not' which means "This dream is not to be taken literally". Sometimes, in very light sleep, one knows that one is dreaming.

Daughter: But, Daddy, you still haven't answered the question about how dreams are put together.

Father: I think really I have answered it. But let me try again. A dream is a metaphor or a tangle of metaphors. Do you know what a metaphor is?

Daughter: Yes. If I say you are LIKE a pig that is a simile. But if I say you ARE a pig, that is a metaphor.

Father: Approximately, yes. When a metaphor is LABELED as a metaphor it becomes a simile.

Daughter: And it's that labeling that a dream leaves out.

Father: That's right. A metaphor compares things without spelling out the comparison. It takes what is true of one group of things and applies it to another. When we say a nation 'decays', we are using a metaphor, suggesting that some changes in a nation are like changes which bacteria produce in fruit. But we don't stop to mention the fruit or the bacteria.

Daughter: And a dream is like that?

Father: No. It's the other way round. The dream would mention the fruit and possibly the bacteria but would not mention the nation. The dream elaborates on the RELATIONSHIP but does not identify the things that are related.

Daughter: Daddy, could you make a dream for me?

Father: You mean, on this recipe? No. Let's take the piece of verse which I read you just now and turn it into a dream. It's almost dream material the way it stands. For most of it, you have only to substitute images for the words. And the words are vivid enough. But the whole string of metaphors or images is pegged down, which would not be so in a dream.

Daughter: What do you mean by pegged down?

Father: I mean by the first word: 'Thought'. That word the writer is using literally, and that one word tells you what all the rest is about.

Daughter: And in a dream?

Father: That word, too, would have been metaphoric. Then the whole poem would have been much more difficult.

Daughter: All right—change it then.

Father: What about "BARBARA changed the infinite …" and so on.

Daughter: But why? Who is she?

Father: Well, she's barbarous, and she's female, and she is the mnemonic name of a syllogistic mood. I thought she would do rather well as a monstrous symbol for 'Thought'. I can see her now with a pair of calipers, pinching her own brain to change her universe.

Daughter: Stop it.

Father: All right. But you see what I mean by saying that in dreams the metaphors are not pegged down.

Daughter: Do animals peg down their metaphors?

Father: No. They don't have to. You see, when a grown-up bird makes like a baby bird in approaching a member of the opposite sex, he's using a metaphor taken from the relationship between child and parent. But he doesn't have to peg down whose relationship he is talking ABOUT. It's obviously the relationship between himself and the other bird. They're both of them present.

Daughter: But don't they ever use metaphors—act out metaphors—about something other than their own relationships?

Father: I don't think so. No—Not mammals. And I don't think birds do either. Bees—perhaps. And, of course, people.

Daughter: There's one thing I don't understand.

Father: Yes?

Daughter: We've found a whole lot of things in common between dreams and animal behavior. They both deal in opposites, and they both have no tenses, and they both have no 'not', and they both work by metaphor, and neither of them pegs the metaphors down. But what I don't understand is—why, when the animals do these things, it makes sense. I mean for them to work in opposites. And they don't HAVE to peg down their metaphors—but I don't see why dreams should be like that, too.

Father: Nor do I.

Daughter: And there's another thing.

Father: Yes?

Daughter: You talked about genes and chromosomes carrying messages about development. Do they talk like animals and dreams? I mean in metaphors and with no 'nots'? Or do they talk like us?

Father: I don't know. But I am sure their message system contains no simple transform of Instinct Theory.

Human(itie)s, Animals and Contemporary Zoosemiotics

Introduction

Timo Maran, Dario Martinelli and Aleksei Turovski (editors)

This final section of the book collects a number of rather heterogeneous contributions (from different fields of animal studies), whose common denominator is the semiotic relation between humans and other animals (that may be called anthropological zoosemiotics, and what partly exists in social sciences under the label anthrozoology). To semiotically compare human beings with other species implies an interest in the areas of pure comparison, communication (reciprocal and intentional interaction between humans and other animals) and representation (how the animal becomes a cultural object).

The four articles selected for this section were meant to ideally (and critically) cover these three areas of inquiry, each article having elements that may be classified according to one or more scheme, and each having the notions of "language" and "culture" as central points (i.e., exactly those notions where the possible continuity between human beings and other species is promoted or argued against).

Donald Griffin's article addresses the question of the differences and similarities between human language and other animals' communication systems. It starts by illustrating the many existing theses in favour of the (distinctive and qualitative) uniqueness of the human language, including those formulated by Leonard Bloomfield, Noam Chomsky, Ernst Cassirer, Susanne Langer, the ever present Descartes, and others, and referring to the argumentative quality that is intrinsic to human language, the direct relation with thinking, its capacity of referring to distant times and places, and—of course—the capacity to produce symbols. The ideal conclusion of this overview, and the main thesis Griffin is planning to discuss, is summarized in Ruth Anshen's words: "Man *is* language".

Griffin's challenge is therefore clear already from the title of his essay: Is man language? To Chomsky's argument that science currently offers no counterargument to Descartes' assumption that human language is the only communication system untied from stimulus control, Griffin notes "sweeping, negative generalizations" (*see p. 345, below*). What in fact science *cannot* demonstrate empirically is the exact opposite: that is, that any particular animal communication system "consists of an absolutely fixed number of signals" (*see p. 345, below*). Neither can it be proved "what eliciting conditions or internal states" (*see p. 345, below*) are associated with each of these systems. Griffin then mentions Jane Goodall's studies on chimpanzees as an example of how non-human communication is in fact creative and adaptable to new situations.

Against the assumption that human language is the only one to contain a symbolic dimension, Griffin revisits the "certainly symbolic" (*see p. 345, below*) nature of bee dances. Against the seemingly exclusive characteristic of human language to be culturally transmitted, Griffin offers Lorenz's observations on the fundamental role of cultural transmission in bird communication, and Frisch's investigation into the variability of the same bee dance. For Griffin, this is also an occasion to point out the difficulty of talking about insect communication, in particular, because of the widely-shared opinion that, of all animal classes, insects seem to be the one *really* and *exclusively* genetically-programmed: "We may be skating on thin ice when we assume that everything about the behavior of social insects results directly from a chain of causal sequences beginning with their DNA and proceeding immutably toward rigidly stereotyped adult behavior in total isolation from any influence of the physical or social environment" (*see p. 348, below*).

The final part of the article focuses on the famous design features of human language, as formulated by Charles F. Hockett. Against the claimed human species-specificity of these features (particularly the ones of discreteness, duality and displacement), Griffin gives a number of counterarguments and browses the features one by one, in order to report examples found in the non-human animal world.

His conclusion confirms the suspicion underlying his whole book, that is, as humans, we solved too soon the problem of the possibilities and the limitations of animal behaviour: "there is no doubt that for centuries philosophers and linguists have based their most fundamental definitions of humanity on very positive assertions about what animals can and cannot do. This means that whatever students of animal communication have learned, or can learn in the future, about communication behavior is directly relevant to major questions of fundamental significance to linguistics and philosophy" (*see p. 352, below*).

Tim Ingold's article represents a slightly different area of investigation in our anthropological zoosemiotics' program, yet it constitutes a continuation, from a more anthropological side, to Griffin's reflections. Is culture a human specificity? This is the first question that Ingold addresses in his article. Hundreds of definitions of culture, he observes, have been produced in recent years, but while taking for granted culture's human species-specificity, they have failed to produce formulations that would indeed apply only to *Homo sapiens*. In this matter, no help is offered by the occasional distinction between a supposedly *true* human culture and a non-human *proto-culture* or the use of the symbolic quality of language as a proof that, unlike in humans, animal information is transmitted only genetically: "What most anthropologists have failed to realize… is that the opposite of symbolically encoded behavior is *not* genetically transmitted behavior, or crudely, 'instinctive' behavior" (*see p. 358, below*).

Ingold does believe in the uniqueness (and profound significance) of human symbolic thought (also in the cognitive sense, in that it allows progress and innovation), but he rejects the idea of using it as a passepartout for explaining everything humans do. On the contrary, most human conduct does *not* differ from other species.[1]

The following sections in the essay are illustrations of these basic theses. In the one entitled "Lewis Henry Morgan and the engineering of the beaver", Ingold notes how Morgan, together with Walter Taylor the godfather of modern anthropology, had suggested that the so-called "thinking principle" (the mind) is a gift that God gave to *all* animal species, not just the human one. The architectural and engineering skills of the beavers are Morgan's main example (cf. Morgan 1868). According to Morgan, notes Ingold, "the beaver is a perfectly self-conscious, intentional agent" (*see p. 362, below*). The difference with humans is therefore not evident. What the beaver lacks is not a mind to think, but a larynx to talk. Animals are "mutes", not dumb.

As a counterpart, Ingold reports Alfred L. Kroeber's thesis on 'The superorganic', and his natural predecessor Karl Marx: to put it in musical terms, the human being, before being a performer, is a composer too. He has, that is, a mental scheme that precedes the actual action: "the human architect, who here denotes cultural man, carries a blueprint of the task to be performed, prior to its performance, whereas the non-human animal does not" (*see p. 364, below*).

In the next paragraph, Ingold then compares Morgan's position to Griffin's reflections on the continuity between human and non-human language, reaching the conclusion that the anthropologist and the zoologist were in fact like-minded. However, the problem, in Ingold's view, is that no investigation has so far been able "to explain why animals that are purportedly capable of linguistic communication when reared in human environment do not manifest this capa-

---

[1] Here we approach Griffin's challenge—to the thesis that man is language—from another perspective. Arguing for this or for other similar capacities of human uniqueness inevitably diminishes the role of perception, embodiment and feeling that relate us to other animals but are nevertheless relevant to our human identity.

bility under 'natural' conditions" (*see p. 366, below*). An attempt to approach this question from a strictly semiotic perspective can be found in Martinelli (2006). Ingold is therefore "fairly sure" that animals *do not* possess linguistic abilities, and he proceeds by commenting, with a bit of pop-cultural irony (Winnie the Pooh and comics are called for support), Griffin's argumentation on the dance of the honey bees. To Ingold, the bee dance cannot be defined as being symbolical as it simply commands action, rather than connoting ideas. Language, Ingold concludes with an argument known in semiotic circles as positing a "modeling system", is thus first of all an instrument of thought, *then* a means for expressing it.

Aware of possible accusations of anthropocentrism, Ingold concludes his essay by offering more arguments in support of his reflections (intentionality and premeditation being the main ones): the main human achievement, he suggests, and witness of its uniqueness is that we are the only species that have been able to make a world for itself.

Dominique Lestel adds to the discussion of the problem with an insight from the social sciences. Social scientists, he argues, are (or have been) surprisingly indifferent to the question of animal cultures (particularly their communication processes) which, in fact, offer several reasons for interest. Possibly, a scientific interaction with biosemiotics, Lestel suggests, could be of benefit for both social scientists and biosemioticians alike.

The article starts with an exhaustive overview of the existing studies on animal cultures. Many of the most relevant studies are listed: from Fisher and Hinde to Goodall. The main point in common, it is observed, is the equaling of "behavioral variations", within an animal community, with the notion of culture *tout court.* Is that acceptable, Lestel wonders, or is it not enough? Lestel fears that "the semiotic dimension of animal cultures has been totally neglected by ethologists" (*see p. 381, below*), and therefore he proceeds by showing that animal communications are much more complex than what is normally believed.

Similarly to Griffin, the argument starts by showing that most of the supposedly distinctive features of human language are, in fact, present in other animals as well: these include traditions, meta-communication, innovation, flexibility, multiple articulation and dialogues. The bee dance is once again taken as the example *par excellence*, but studies on chimpanzees are mentioned too.

However, Lestel notices, the problem might lie in the dichotomy continuity/discontinuity in the comparison between human and other communication systems, a dichotomy which reveals a biased methodology. Who gives us the right to use human language as the term of comparison? Why does a judgment need to be made on the basis of similarity and dissimilarity with *this very* communication system? “The space of animal communications is as yet largely virgin territory” (*see p. 385, below*), full of assumptions that are far from being empirical (like Bateson’s observation on the lack of “negation” in animal communication, severely contradicted by very many counterexamples).

The issue is indeed much more complex, and involves different methodologies: the introduction of zoosemiotics in 1963, by Thomas A. Sebeok, certainly represents a milestone in this sense. And so does the rediscovery of von Uexküll in the early 1980’s. In general, “Today’s biosemiotic approaches present the advantage of placing the question of meaning in a broader evolutionist perspective which avoids the necessity of a miraculous break, and then the sudden appearance of meaning. On the contrary, meaning is seen as co-present with living beings from the beginning; it is the modalities of expression which change and grow in complexity.” (*see p. 388, below*).

The next section of the essay is entitled “Can animals be subjects?”. Here, Lestel specifies that he prefers the term “subject” (more psychologically-connoted) to the more juridically-oriented, but similarly-meant “person” defended by the above mentioned Ingold. It is not a new idea, as Lestel himself admits by reporting Frederik Buytendijk (a student of von Uexküll’s) and his idea of animals as “structuring structures”. Yet, it is an open and urgent question, not simply from an ethical point of view, but mostly—in this context—in “Determining what status to attribute to the ‘speakers’ involved in animal communications” (*see p. 390, below*).

A more rarely addressed question emerges in the following section of the essay. Is animal communication altered by contact with humans, and how? Of course, the central topic here is interspecific communication, in the form of the many attempts to teach human languages to other species, particularly great apes. Lestel takes the not-so-common perspective of how the animal subject, not the human one, experiences a situation of this kind. What scholars seem to forget, more often than not, is that “each animal has a name and a history. It is a subject before being a laboratory animal” (*see p. 393, below*).

One of the implications of looking at the problem, so to speak, *from the other side*, lies also in the formulation of different questions: interspecific communication experiments are not only investigating the ability of non-human animals to acquire human language. They also explore the potentials of human–animal hybrid communities. Specifically, both humans and apes form *semiotic communities*, which are communities in all respects, as they share rationality. “We thus need to rethink the role and the importance of human/animal relations when attempting to draw up a history of the cultural rationalities developed together by humans and animals in their various associations” (*see p. 396, below*).

Lestel's conclusions are in the form of questions: "would human societies have developed in the same way in a space without animals?" (*see p. 402, below*). And then, "what place do human societies assign animals in their organizations?" (*see p. 402, below*). The role played by animals in human societies is crucial, and it strikes Lestel as unusual that so little importance has been attributed to this role in so many different fields of inquiry, whether human or natural sciences.

The last article in this section is a collaboration between biosemiotician Kalevi Kull and cultural semiotician Peeter Torop. Its main point is a redefinition of the concept of translation in such a way that it includes sign-processes in non-humans. Is an expression such as "talking with nature" only metaphorical? Are interspecific messages *translated* into each interlocutor's specific "language"? Do we translate the meowings of our cat, and does s/he translate our human words? These questions are relevant for zoosemiotics, as they aim to explain many forms of interspecific communication where different species use different codes, thus raising the question how mutual understanding or coordinated behaviour can be achieved.

Kull and Torop distinguish the concept of *pro-*(or *bio-*)*translation* from that of *eu-*(or *logo-*)*translation*, respectively, in terms of unconscious and conscious processes. The main difference between the two categories lies in who or what is the *translator*, and since most translation theories are formulated independently from this role, then it is logically acceptable to develop a theory of biotranslation too. At the same time, using the concept of translation in biological contexts inevitably raises again the issue of language in non-human animals. Is translation possible between language-free or, more properly, between syntax-free sign systems, or should we rather attribute those phenomena also to other animals. Authors try to solve this question by distinguishing prosyntax as relations between categories: "Categorisation process always presumes a relationship between categories—two things cannot be distinguished without any relationship of one to the other" (*see p. 415, below*)

So, what is translation, for biology? Kull and Torop refer here to von Uexküll's theory of Umwelt: "that translation also means that some signs in one Umwelt are put into a correspondence with some signs in another *Umwelt*" (*see p. 414, below*). The diverse characteristics of biotranslation then follow, and also further problems emerge. For instance, given this definition of translation, how can we define "sign" in biology? Here Kull and Torop borrow again from von Uexküll's work and argue towards the creation of a correspondence between the traditionally semiotic notions of sign, denotatum and interpretant, with the Uexküllian concepts of *Merkzeichen*, *Wirkzeichen* and *Funktionskreis*. This allows development of a more operational understanding of signs.

In animals much information is communicated not horizontally but vertically in time, that is, between generations. Thus, one may wonder if different types of inheritance (epigenetic, genetic, behavioural, and linguistic, cf. Jablonka and Lamb 2005) could also be considered as involving a translation process? The authors claim that behavioural and linguistic patterns form distinctive inheritance systems that can be translated. The question of inheritance is finally approached from a genetic (and epigenetic) perspective. Translation, in such contexts, is a term often used, but only as a metaphor. Is it something more than that? The question is not brought to a conclusion but left open: "As applied to one particular step in protein synthesis, it is and should stay as a metaphor. However, this same process certainly is a constituent part of a bio-translation process, in which a daughter cell interprets the genome inherited from its mother cell, but the whole process is much richer than the one named as translation in molecular biology" (*see p. 421, below*).

References

Jablonka, Eva and Marion Lamb
2005 *Evolution in Four Dimensions: Genetic, Epigenetic, Behavioral and Symbolic Variation in the History of Life*. Cambridge, MA: MIT Press.

Martinelli, Dario
2006 Language and interspecific communication experiments: A case to reopen. Marcello Barbieri (ed.), *Introduction to Biosemiotics. The New Biological Synthesis*, 473–517. Berlin: Springer.

Morgan, Lewis H.
1968 *The American Beaver and His Works*. Philadelphia, Pennsylvania: Lippincott.

Is Man Language?*

Donald R. Griffin

The linguist Bloomfield (1933) recognized that animals do communicate, but concluded: "Human speech differs from the signal-like actions of animals, even of those which use the voice, by its great differentiation. Dogs, for instance, make only two or three kinds of noise—say, barking, growling, and whining… When we tell someone, for instance, the address of a house we have never seen, we are doing something which no animal can do." The molecular biologist Monod (1975) reiterated the widespread view that "man is endowed with a completely unique capacity, which no other species shares, namely language… There is nothing argumentative for instance, in animal communication." This opinion overlooks the many cases where animals exchange ritualized threat signals and can reasonably be considered to be arguing about who should retreat. And before swarming honeybees have reached a consensus about the cavity to which they will emigrate, as discussed in Chapter 3, their conflicting dance messages have many attributes of an argument. Presumably Monod was using the term argumentative to mean exchanges of more complex and reasoned statements.

Many philosophers and linguists have also argued that human language is closely linked with thinking, if not identical and inseparable from it (Cassirer, 1953; Fodor et al., 1974; Hattiangadi, 1973; Healy, 1971; Lenneberg, 1971; Pyles, 1971; Thass-Thienemann, 1968; Weiss, 1975). Langer has expounded this view in several contexts (1942, 1967, 1972) and with special eloquence and vigor (1962): "language is symbolic, when no animal utterance shows any tendency that way. The biological factors that caused this great shift in the vocal function were, I believe, the development of visual imagery in the humanoid brain, and the part it came to play in a highly exciting, elating experience, the festal dance." This was written only a few years before Goodall (1968, 1971) described what appeared to be highly excited "rain dances" of chimpanzees, in

---

* From: Griffin, Donald R. 1981. Is man language. In: Donald R. Griffin. The Question of Animal Awareness: Evolutionary Continuity of Mental Experience, 73–85. New York: Rockefeller University Press. Reproduced with permission of Rockefeller University Press.

which the adult males of a social group respond to the first heavy rains by violent displays that include loud pant-hoots, rushing about, and breaking off branches from trees. Langer continued: "As I remarked before, images are more prone than anything else we know to become symbols… In animals typically, every stimulation that takes effect at all is spent in some overt act…" (Langer, 1962). "A genuine symbol is, above all, an instrument of conception, and cannot be said to exist short of meeting that requirement; that means that an ape thinking symbolically could think of an act he had no intention or occasion to perform, and envisage things entirely remote from his real situation… Symbolism is the mark of humanity" (Langer, 1972). These views may have been expressed before the full impact of the Gardners' breakthrough concerning chimpanzee communication had been felt, and before the experiments of Menzel and Halperin (1975). But it is now clear that some animals communicate complex messages so closely attuned to the nuances of the social situation that great caution is called for in reaching such definite conclusions as those expressed by Langer.

Black (1968) assured us that "It would be astounding to discover insects or fish, birds or monkeys, able to *talk to one another*… [because] … Man is the only animal that can talk … that can use *symbols* … the only animal that can truly *understand* and *misunderstand.* On this essential skill depends everything that we call civilization. Without it, imagination, thought—even self-knowledge—are impossible." The neurologist Critchley (1960) was so impressed by human speech that he wondered: "Can it be, therefore, that a veritable Rubicon does exist between animals and man after all? … Can it be that Darwin was in error when he regarded the differences between man and animals as differences merely in degree?" Goldstein (1957) asserted in the same vein that "Language is an expression of man's very nature and his basic capacity… Animals cannot have language because they lack this capacity. If they had it, they would … no longer be animals. They would be human beings." To Anshen (1957), "Man *is* language." The influential contemporary philosopher Noam Chomsky, in his penetrating discussions of the nature of language (Chomsky, 1966, 1972), subscribes to the tradition widely attributed to Descartes. To both Descartes and Chomsky, language is the essence of humanity. In a blend of translation and eloquent reiteration, Chomsky (1966) ably summarizes the Cartesian view that no men are "so depraved and stupid, without even excepting idiots, that they cannot arrange different words together, forming of them a statement by which they make known their thoughts; while, on the other hand, there is no other animal, however perfect and fortunately circumstanced it may be, which can do the same … man has a species-specific capacity, a unique type of intellectual organization which cannot be attributed to peripheral organs or related to general intelligence and which manifests itself in what we may refer to as the 'creative aspect' of ordinary language use—its property of being both unbounded in scope and stimulus-free… Human reason, in fact, is a universal instrument which can serve for all contingencies, whereas the organs of an animal or machine have need of some special adaptation for any particular action … no brute [is] so perfect that it has made use of a sign to inform other animals of something which had no relation to their passions … for the word is the sole sign and the only certain mark of the presence of thought hidden and wrapped up in the body; now all men … make use of signs, whereas the brutes never do anything of the kind; which may be taken for the true distinction between man and brute." Chomsky continues, "The unboundedness of human speech, as an expression of limitless thought, is an entirely different matter [from animal communication], because of the freedom from stimulus control and the appropriateness to new situations. Modern studies of animal communication so far offer no counterevidence to the Cartesian assumption that human language is based on an entirely different principle. Each known animal communication system either consists of a fixed number of signals, each associated with a specific range of eliciting conditions or internal states, or a fixed number of 'linguistic dimensions', each associated with a non-linguistic dimension." The evidence reviewed in Chapter 3 calls into serious question these sweeping, negative generalizations of Descartes and Chomsky.

It is difficult to ascertain whether the communication behavior of any particular animal consists of an absolutely fixed number of signals or to establish just what eliciting conditions or internal states are associated with each. Thus Chomsky's assertion of numerical fixity must remain simply an unsupported opinion. It seems quite possible that the perceived rigidity and limitation to a few specific conditions or states exists in the minds of human commentators rather than in the real world of animal behavior. Human language and the thoughts that it expresses are not infinite in their scope and inventiveness, as implied by Chomsky and others. If they were, we might not need such elaborate educational systems to develop our mental and linguistic abilities. Animal behavior, and in particular animal communication, is also adaptable to new situations and is even creative, at least under some circumstances. Consider, for example, how Mike, a Gombe Stream chimpanzee, used kerosene cans to enhance the acoustical component of the charging displays by which he displaced the previously dominant males of his social group (Goodall, 1971, pp. 112–117). Mike's use of a wholly new type of noise-making object in intermale encounters showed every sign of being an intentional effort to improve his social status, and seems to have been a creative, rather than a stereotyped, behavior pattern.

Price (1938) argued that if animals use symbols, we must assume they have minds. Bee dances are certainly symbolic, but Chomsky (1972) maintains that one cannot trace similarities and evolutionary continuities between animal and human communication. “When we ask what human language is, we find no striking similarity to animal communication systems … human language, it appears, is based on entirely different principles. This, I think, is an important point, often overlooked by those who approach human language as a natural, biological phenomenon; in particular, it seems pointless, for these reasons, to speculate about the evolution of human language from simpler systems… As far as we know, possession of human language is associated with a specific type of mental organization, not simply a higher degree of intelligence. There seems to be no substance to the view that human language is simply a more complex instance of something to be found elsewhere in the animal world.” Cultural transmission of human language has often been cited as one criterion establishing it as unique to our species. For example, Pollio (1974) states three criteria necessary to qualify an event as a symbol: it must be representative of some other event, “freely created,” and transmitted by culture. The dances of honeybees are recognized as being representative, but are held to be too rigid and unvarying to satisfy the second criterion, and to be genetically programed rather than culturally transmitted.

The influential views of Chomsky also include a belief that the capability for learning and using language is a species-specific human attribute. Although he does not say so explicitly, it is difficult to escape the conclusion that Chomsky feels there must be a substantial genetic component in the development of our ability to use language; this is strongly implied in the way in which he refers to it as species-specific. Pollio’s and Chomsky’s position on this species-specificity in *Homo sapiens* is a bit ambiguous, because they also seem to believe that culture is another unique human attribute. Culture has been defined in many ways, but basically it is used to mean a shared set of learned behavior patterns for regulating social interactions. Some, but not all, anthropologists’ definitions imply that people who share a culture consciously understand the rules they have learned in order to regulate social behavior.

Lorenz (1969) has reviewed the considerable evidence that cultural transmission is important in the social behavior and communication of birds. Sarles (1975) has reviewed the difficulty of basing a rigid human-animal dichotomy on the criterion of language. It has recently become apparent to several thoughtful ethologists and others that many social animals learn the kinds of behavior which enable their societies to function effectively. There seems to be a real, though relatively simple, type of culture present in many nonhuman animals, especially primates and songbirds, as described in some detail by Bonner (1980) and Mundinger (1980). We have tended to take it for granted that only people are consciously aware of the social relations that make up their culture, and that nonhuman animals, no matter how much they may learn to cooperate, are unthinking automata. But accumulating evidence makes it almost impossible to defend rigorously any qualitative dichotomy.

This brings us back to the question of rigidity and total genetic programing in the behavior of social insects, honeybees in particular. Under some conditions, the waggle dances do vary considerably, and they are not performed at all unless certain social conditions are present. As I have mentioned earlier, there is a great deal of communication among members of a hive of bees, largely through exchange of stomach contents and transmission of chemical signals. This serves to regulate the activities of the workers and stimulate some of them to search for particular materials when these are in short supply. Part of this social regulation consists of the reception a returning forager receives when she tries to exchange food with one of her sisters. If the material regurgitated is not accepted by the other bee, the returning forager has difficulty finding a taker for her stomach contents and is less likely to seek more of the material. This process of social regulation has been well studied in hives that become overheated; this causes a marked change in the behavior of the foragers. Instead of searching for and bringing back nectar or other concentrated sugar solutions, they search for water, which cools the hive as it evaporates (Frisch, 1967; Lindauer, 1971a).

Furthermore, the specific dance patterns used to convey information about the location and quality of a given source of food must be learned and remembered by the individual worker on each occasion. The counterargument is that relatively rigid genetic instructions cause worker bees to behave in ways which serve this communicative function, even though individual elements of the behavior are influenced by learning. Although it is clear that bee-dancing is under much stronger genetic control than is human language, the two communication systems have important qualitative elements in common. The prevailing view of insect behavior holds it to be controlled entirely by genetic programing, or at least that insects are programed to learn only certain things under particular conditions. Bees are thus viewed as complex automata equipped with "on-board computers" that have been genetically programed by natural selection to cope with all eventualities (Gould, 1979). The postulated programs must of course provide for rare but important situations, like the need to seek out and report the location of new cavities at the time of swarming. But can people learn absolutely anything, and do we learn equally well under all circumstances? Our patterns of thinking about other species place such great emphasis on genetic control of their behavior that we tend to slip very easily into unqualified assertions.

The view that insects are genetically programed automata is so widely and deeply accepted, even by ethologists, that it is extraordinarily difficult to accept the implications of the versatile communication system discovered in honeybees by Frisch. It almost seems as though one must choose between the "robot" view of insects and what would otherwise be overwhelmingly convincing experimental evidence that honeybees communicate with each other in a flexible manner capable of dealing with any of several different subjects, including new problems of great importance. The very fact that we would readily accept the bee dances as evidence of intentional communication if they had been discovered in primates, rather than in insects, should warn us that our frame of reference may not be sufficiently flexible to take advantage of truly revolutionary new discoveries.

It is also worthwhile to consider the overwhelming mutual interdependence of such social insects as honeybees. No individual can survive for any extended period in isolation, and reproduction is entirely dependent on an elaborate series of behavior patterns in which nonreproductive animals contribute directly and indirectly in numerous ways to the feeding, protection, cleaning, and other aspects of the behavior of the queen or reproductive females. Furthermore, the development of each individual egg is very different from the preprogramed growth and differentiation of an isolated zygote. At many stages during larval and pupal stages, older bees feed and clean the developing egg, larva, or pupa, and protect it through numerous activities necessary for maintaining the colony. Even the sex of an individual bee is strongly influenced by chemical materials supplied by other members of the genetically related colony. To the best of our knowledge, the communicative dances of a given genetic strain of honeybee always take a very similar, if not precisely identical, form, but species-specificity does not necessarily mean total control by the genotype. Social influences during the lifetime of the individual could well have some effect, as Schneirla (1966), Lehrman (1953), Hinde (1970), Gottlieb (1971), and others have argued for birds and mammals.

In short, we may be skating on thin ice when we assume that everything about the behavior of social insects results directly from a chain of causal sequences beginning with their DNA and proceeding immutably toward rigidly stereotyped adult behavior in total isolation from any influence of the physical or social environment. Such arguments would be more plausible if the egg developed in a wholly isolated situation and was not so abundantly and directly influenced by care-taking behavior. In very general terms, it seems clear that genetic instructions affect the ability of the adult organism to learn a particular type of communicative behavior. As in almost all nature-nurture considerations, there are good reasons to believe that both genetic and environmental influences are of major importance in shaping the adult animal and its behavior. The same considerations can be applied to honeybee dances and, as emphasized by Chomsky (1966, 1972), to human language.

Of course, no one in his senses can overlook the enormous differences in complexity, subtlety, and versatility that separates human language from any known, or even speculatively postulated, communication between members of other species. But most scholars and scientists concerned with the question have not been content with quantitative distinctions—differences in degree rather than differences in kind. Thus, Hockett (1958) made an effort to formulate objective criteria by which human language can be qualitatively distinguished from animal communication.

Hockett's original list has been modified by Hockett and Altmann (1968) and by Thorpe (1972a, 1974a, 1974b) in an attempt to encompass the variety that exists in animal communication and yet to distinguish features unique to human language. Although the task seems to become increasingly difficult as more and more is learned about communication in other species, it is important to review the 16 design features included by Thorpe (1974a) in the latest version of this general scheme: (1) use of the *vocal-auditory channel*; (2) *broadcast transmission and directional reception*; (3) *rapid fading;* (4) *interchangeability* (the same individual can act either as transmitter or receiver of information); (5) *complete feedback* (the organism emitting the signal also perceives everything relevant about the message); (6) *specialization* (relatively weak signals trigger biologically important consequences); (7) *semanticity* (the communication system is used to correlate and organize the life of a community); (8) *arbitrariness* (signals or symbols are abstract, in that the meaning they convey is independent of their physical properties); (9) *discreteness* (signals are unitary entities and do not grade continuously into one another); (10) *displacement* (discussed in Chapter 3); (11) *openness* or *productivity* (meaning that new messages can readily be created and understood); (12) *tradition* (conventions passed on from one generation to the other by learning); (13) *duality of patterning* (while single units of the communication may be meaningless, patterned combinations of them convey important information); (14) *prevarication* (using communication signals to convey information known to be inaccurate); (15) *reflectiveness* (the ability to communicate about the communication system itself); and (16) *learnability* (the ability of a user of one communication system to learn another one employed by a different group of organisms). All of these features are certainly present in human language, and the question that arises is the degree to which any of them, or any combination, provide an objective basis for concluding that there is a fundamental difference in kind between human language and all communication systems used by other animals.

Most of the 16 design features are, in fact, present in many animal-communication systems. These include *reliance on the vocal-auditory channel*; *broadcast transmission and directional reception; rapid fading*; *interchangeability* (animals can act both as transmitters and receivers); *specialization* (energy in the signal small compared to the effects triggered by it); and *complete feedback* (transmitting animal able to perceive all relevant properties of his signal). Another set of design features seems, at first thought, to be distinctively human, but similarities are certainly present in many animals. These include *semanticity*, defined as use of signals to correlate and organize the activities of a community on the basis of associations between the signals and properties of the surrounding world. Many animal communication signals certainly satisfy this criterion in a general way. For example, territorial songs of birds and the social communication of primates correlate in an important fashion with the properties of the environment as far as conspecifics are concerned. Chemical and gestural communication is crucial in coordinating the mutually beneficial activities of social insects.

Arbitrariness is another criterion that falls into this category. Bee dances often are considered not to be arbitrary because the dance pattern is a sort of iconic replica of the route to be flown. But there are so many other aspects of the dances, such as their vigor and the role of sounds of vibrations in conveying something akin to the urgency of the message, that it becomes little more than a matter of semantics whether to designate these features as arbitrary. For example, the use of "up" as a point of reference meaning toward the sun is arbitrary; the system would work equally well if "down," or "90 degrees to the right of up," meant toward the sun. To be sure, all honeybee colonies use this same convention, in contrast to human languages, where a given meaning is often conveyed by quite different words.

Eight other design features are more difficult to find outside of human language. *Discreteness* is an important property of human linguistic communication, in that small elements, such as words or syllables, do not functionally grade into one another. But the definition of discreteness depends heavily upon the size of element considered. For example, a single cycle of the honeybee dance or even a single cycle of abdomen waggling could well be considered a discrete unit. The latter, in particular, is combined in various ways with other elements, such as sound pulses. Jostling and bumping seem to elicit a rather generalized state of arousal in many insects. But in the waggle dance, as discussed in Chapter 7, individual movements have been combined into an organized pattern which conveys a much more specific meaning: "this way, and this far." Two other features—tradition, the meaning of signals transmitted by teaching and learning, and *learnability*, users of the communication system learning about it from another—are closely related and can best be considered together. It is clear that learning and social tradition play a large role in the details of bird song and other types of social communication (Smith, 1977; Green and Marler, 1979;

Mundinger, 1980; and Bonner, 1980). Bee dances are generally considered to be genetically programed, but here, too, the details are certainly learned, as when bees visit and dance about a location conveyed to them by other dancers. It is difficult to disentangle genetic and environmental effects in the development of complex behavior in animals that live in such interdependent societies as those of honeybees, as critically discussed by Marler et al. (1980).

Another design feature frequently stated to be lacking in animal communication systems is *duality.* A system is said to have duality if signal elements are meaningless in themselves but become meaningful when formed into appropriate combinations. Here, again, the applicability of the criterion depends upon the size of unit considered. Bee dances or other forms of communication behavior can easily be subdivided into individual elements, such as single muscle contractions, which by themselves have no communicative significance. Human language obviously achieves a great deal of its enormous importance by use of compound and complex combinations of small elements; but we do not know enough about animal communication to judge the degree to which combinations, as opposed to individual signals, may be important.

One design feature often considered unique to human language is *displacement.* As discussed in Chapter 3, displacement means that the communication process can refer to things remote in time or space. Clearly, bee dances and the recruiting gestures of weaver ants satisfy this criterion. Another similar criterion is *openness*, meaning the ease and frequency with which new messages are coined by using previously unused combinations of elements of the communication system. This is sometimes also called *productivity*. Ever since Frisch's first decoding of the waggle dances, it has been obvious that they often concern locations and kinds of food about which the bees have never danced before. And when swarming bees exchange reports about the location and desirability of the cavities they have located, the whole subject matter of the communication is a brand new one for the individuals involved. Beer (1975) believes that some calls used by gulls are "semantically and pragmatically open," as will be discussed in Chapter 10.

The fifteenth criterion, *reflectiveness*, the ability to communicate about the communication system itself, is a relatively recent addition to the list. Thorpe feels this property "is undoubtedly peculiar to human speech," yet we should ask ourselves whether, if it does occur in animals, any of our available methods of investigation would suffice to disclose it. The discussion of self-awareness in Chapter 2 is pertinent to this issue. Although it was not mentioned in this context by Hockett and Altmann, *prevarication* is one more criterion commonly advanced to set our species apart from other animals. I will discuss it further in the next chapter.

Thorpe accepts the available ethological evidence, especially the studies of chimpanzees by the Gardners and by Premack, as convincing evidence that apes, at least, and probably also dogs and wolves, clearly demonstrate conscious purposiveness. He feels it is likely that, if the chimpanzee larynx were adequate, these apes could learn to speak as well as children three years old, or perhaps older. To Thorpe, "human speech is unique only in the way it combines and extends attributes which, in themselves, are not peculiar to man but are found also in more than one group of animals. ... Yet ... there comes a point where 'more' creates a 'difference'". Here he aptly quotes A. N. Whitehead (1938): "The distinction between men and animals is in one sense only a difference in degree. But the extent of the degree makes all the difference. The Rubicon has been crossed." It is only fair to point out that many of the opinions discussed above date from the "pre-Washoe" period of ethology, and might not reflect the considered views which these authors would now hold. Yet there is no doubt that for centuries philosophers and linguists have based their most fundamental definitions of humanity on very positive assertions about what animals can and cannot do. This means that whatever students of animal communication have learned, or can learn in the future, about communication behavior is directly relevant to major questions of fundamental significance to linguistics and philosophy.

References

Anshen, R. N.
1957 Language as Idea. In: Anshen, R. N. (ed.), *Language: An Enquiry into its Meaning and Function.* New York: Harper.

Beer, C. G.
1975 Multiple Functions and Gull Displays. In: Baerends, G., Beer, C. G., and Manning, A. (eds.), *Essays on Function and Evolution in Behaviour: A Festschrift for Professor Niko Tinbergen.* Oxford: Clarendon, Chapter 2.

Black, M.
1968 *The Labyrinth of Language*. New York: Praeger.

Bloomfield, L.
1933 *Language.* New York: Holt (Reprinted 1961 by Holt, Rinehart & Winston).

Bonner, J. T.
1980 *The Evolution of Culture in Animals.* Princeton, N.J.: Princeton Univ. Press.

Cassirer, E.
1953 *The Philosophy of Symbolic Forms.* Vol. 1. *Language.* New Haven: Yale Univ. Press.

Chomsky, N.
1966 *Cartesian Linguists.* New York: Harper & Row.

Chomsky, N.
1972 *Language and Mind.* New York: Harcourt Brace Jovanovich.

Critchley, M.
1960 The Evolution of Man's Capacity for Language. In: Tax, S. (ed.), *Evolution after Darwin.* Vol. II. Chicago: Univ. of Chicago Press.

Fodor, J. A., T. G. Bever, and M. F. Garrett
1974 *The Psychology of Language.* New York: McGraw-Hill.

Frisch, K. von
1967 *The Dance Language and Orientation of Bees.* (Translation by L. Chadwick.) Cambridge: Harvard Univ. Press.

Goldstein, K.
1957 The Nature of Language. In: Anshen, R. N. (ed.), *Language: An Enquiry into its Meaning and Function.* New York: Harper, Chapter 2.

Goodall, J. van Lawick
1968 Behavior of free-living chimpanzees of the Gombe Stream area. *Anim. Behav. Monogr.* 1:165–311.

Goodall, J. van Lawick
1971 *In the Shadow of Man.* Boston: Houghton Mifflin.

Gottlieb, G.
1971 *Development of Species Identification in Birds, an Inquiry into the Prenatal Determinants of Behavior.* Chicago: Univ. of Chicago Press.

Gould, J. L.
1979 Do honeybees know what they are doing? *Nat. Hist.* 88:66–75.

Green, S. and P. Marler
1979 The Analysis of Animal Communication. In: Marler, P., and Vandenbergh, J. G. (eds.), *Handbook of Behavioral Neurobiology*, Vol. 3. *Social Behavior and Communication.* New York: Plenum.

Hattiangadi, J. N.
1973 Mind and the origin of language. *Philos. Forum* 14:81–98.

Healy, A. F.
1971 Can chimpanzees learn a phonemic language? *J. Psycholinguist Res.* 2:167–170.

Hinde, R. A.
1970 *Animal Behavior: A Synthesis of Ethology and Comparative Psychology.* New York: McGraw-Hill.

Hockett, C. F.
1958 *A Course in Modern Linguistics.* New York; Macmillan.

Hockett, C. F. and S. A. Altmann
1968 A Note on Design Features. In: Sebeok, T. A. (ed.), *Animal Communication.* Bloomington: Indiana Univ. Press, Chapter 5.

Langer, S. K.
1942 *Philosophy in a New Key.* New York: Pelican Books.

Langer, S. K.
1962 *Philosophical Sketches.* Baltimore: Johns Hopkins Press.

Langer, S. K.
1967 *Mind: An Essay on Human Feeling.* Vol. I. Baltimore: Johns Hopkins Press.

Langer, S. K.
1972 *Mind: An Essay on Human Feeling.* Vol. II. Baltimore: Johns Hopkins Press.

Lehrman, D.
1953 A critique of Konrad Lorenz's theory of instinctive behaviour. *Q. Rev. Biol.* 28:337–363.

Lenneberg, E. H.
1971 Of language knowledge, apes, and brains. *J. Psycholinguist. Res.* 1:1–29.

Lindauer, M.
1971a *Communication among Social Bees* (revised edition). Cambridge: Harvard Univ. Press.

Lorenz, K.
1969 Innate Bases of Learning. In: Pribram, K. H. (ed.), *On The Biology of Learning.* New York: Harcourt Brace and World.

Marler, P. R., R. J. Dooling, and S. Zoloth
1980 Comparative Perspectives on Ethology and Behavioral Development. In: Bornstein, M. H. (ed.), *Comparative Methods in Psychology.* Hillsdale, N.J.: Erlbaum.

Menzel, E. W., Jr. and S. Halperin
1975 Purposive behavior as a basis for objective communication between chimpanzees. *Science* 189:652–654.

Monod, J. L.
1975 On Molecular Theory of Evolution. In: Hane, R. (ed.), *Problems of Scientific Revolution, Progress and Obstacles to Progress in the Sciences.* London: Oxford Univ. Press.

Mundinger, P. C.
1980 Animal cultures and a general theory of cultural evolution. *Ethol. Sociobiol.* 1:183–223.

Pollio, H. R.
1974 *The Psychology of Symbolic Activity.* Reading, Mass.: Addison-Wesley.

Price, H. H.
1938 Our evidence for the existence of other minds. *Philosophy* 13:425–456.

Pyles, T.
1971 *The Origins and Development of the English Language.* 2nd ed. New York: Harcourt Brace Jovanovich.

Sarles, H.
1975 Language and Communication. II: The View from '74. In: Pliner, P., Krames, L., and Alloway, T. (eds.), *Nonverbal Communication of Aggression.* New York: Plenum.

Schneirla, T. C.
1966 Behavioral development and comparative psychology. *Q. Rev. Biol.* 41:283–302.

Smith, W. J.
1977 *The Behavior of Communicating: An Ethological Approach.* Cambridge: Harvard Univ. Press.

Thass-Thienemann, T.
1968 *Symbolic Behavior.* New York: Washington Square Press.

Thorpe, W. H.
1972a Duetting and antiphonal signing in birds. Its extent and significance. *Behaviour (Suppl.)* 18:1–197.

Thorpe, W. H.
1974a *Animal Nature and Human Nature.* Garden City, N.Y.: Doubleday.

Thorpe, W. H.
1974b Reductionism in Biology. In: Ayala, F. J., and Dobzhansky, T. (eds.), *Studies in the Philosophy of Biology, Reduction and Related Problems.* Berkeley: Univ. of California Press, Chapter 8.

Weiss, D. D.
1975 Professor Malcolm on animal intelligence. *Philos. Rev.* 84:88–95.

Whitehead, A. N.
1938 *Modes of Thought.* New York: Macmillan.

The Animal in the Study of Humanity*

Tim Ingold

Learning, Symbolism and the Limits of Humanity

The study of culture, we commonly suppose, is a branch of anthropology, that is of the study of humanity. Most people seem to agree that the source of human pre-eminence (if human beings *are* pre-eminent) lies in the phenomena of culture, and that the task of anthropology is to study them; yet nobody can agree on what culture actually is. Definitions of culture are legion: one compilation, attempted more than 30 years ago, amassed no fewer than 161 different definitions (Kroeber & Kluckhohn 1952). By now there must be at least twice as many. Part of the problem is that many of the simpler definitions, such as that 'culture is learned (or acquired) behaviour', conspicuously fail to isolate anything that is specifically human, or merely sidestep the issue by substituting one problematic term (learning) for another (culture).

That much of the behaviour of non-human primates is acquired by a learning process is plainly evident to anyone who has worked with them. Moreover, there is no obvious break in learning abilities between primates and other mammalian species (Harlow 1958). Among birds the non-genetic transmission of components of song is well-established (Thorpe 1961, pp. 71–92). Going further down the scale, it may be recalled that in his latter years, Charles Darwin performed an ingenious series of experiments that conclusively demonstrated the existence of quite advanced learning capacities in earthworms (Reed 1982). A century later we find Bonner, in a beautiful book on *The evolution of culture in animals*, admitting rather reluctantly that although the colony of bacteria in his Petri dish do not exactly learn, 'they do have the basic response system' (Bonner 1980, p. 56)!

If earthworms learn, and if culture is learned behaviour, it follows that earthworms have culture. What, then, becomes of our cherished idea that the study

---

* From: Ingold, Tim 1988. The animal in the study of humanity? In: Tim Ingold (ed.). *What is an Animal?* (*One World Archaeology 1*), 84–99. London, Boston: Unwin Hyman. Copyright © 1988. Unwin Hyman. Reproduced by permission of Taylor and Francis Books UK.

of culture is an aspect of the study of humanity? To solve the problem, as some writers do, by distinguishing between the 'proto-culture' of non-human animals (Hallowell 1962) and the 'euculture' of human beings (Lumsden & Wilson 1981, p. 3) hardly helps, unless we can adduce independent criteria by which these kinds of culture are to be set apart. One possible solution, much favoured by contemporary anthropology, is to refocus the definition of culture upon the notion of the *symbol*. Its primary reference is then no longer to non-genetic (or 'social') modes of behavioural transmission, but to the conceptual organization of experience, or 'the imposition of an arbitrary framework of symbolic meaning upon reality' (Geertz 1964, p. 39, see also Holloway 1969, p. 395). What most anthropologists have failed to realize, however, is that the opposite of symbolically encoded behaviour is *not* genetically transmitted, or crudely 'instinctive' behaviour. For although all learning depends on the association of individuals, only when it involves teaching does it depend on the articulation of a symbolic blueprint or model for conduct. No such model is required for observational learning, of the kind that is common to both humans and non-human animals. Hence the boundaries between instinct and learning, as modes of intergenerational transmission of behavioural instructions, and between practices that are and are not grounded in a symbolically constructed matrix, *do not coincide.*

The latter boundary, I would argue, is what is generally implied in the distinction between the innate and the artificial; an artefact being defined as any object that results from the imposition of prior conceptual form upon material substance (Ingold 1986a, pp. 344–7). Thus, confusion arises because of the non-congruence of the two oppositions: instinctive versus learned, and innate versus artificial. The gross assumption of so many anthropological texts, that whatever cannot be claimed for the symbolic must be relegated to the instinctive, simply will not do, since it leaves altogether out of account the vast field of behaviour that is transmitted by learning (and which consequently will not be manifested by individuals deprived of contact with conspecifics at crucial moments of ontogenetic development), but which is *not* underwritten by a prior symbolic plan.

Moreover, this field of behaviour, which we could call *traditional*, overlaps the boundary between human and non-human conduct. On the one hand, we find local or regional traditions—or 'behaviour dialects' as they are sometimes known in ethological literature—not only among such 'almost human' animals as chimpanzees, but in social species (for example, of birds) far removed from man in the scale of nature (Beck 1982). On the other hand, a great deal of human behaviour, considered to be 'cultural' merely because it is learned, is effectively innate rather than symbolically grounded. It follows that neither of the oppositions I have mentioned, instinctive versus learned and innate versus artificial, serves to isolate the domain of the specifically human. The former is far too broad, whereas the latter is too narrow, isolating not the totality but only a small subset of the totality of human works.

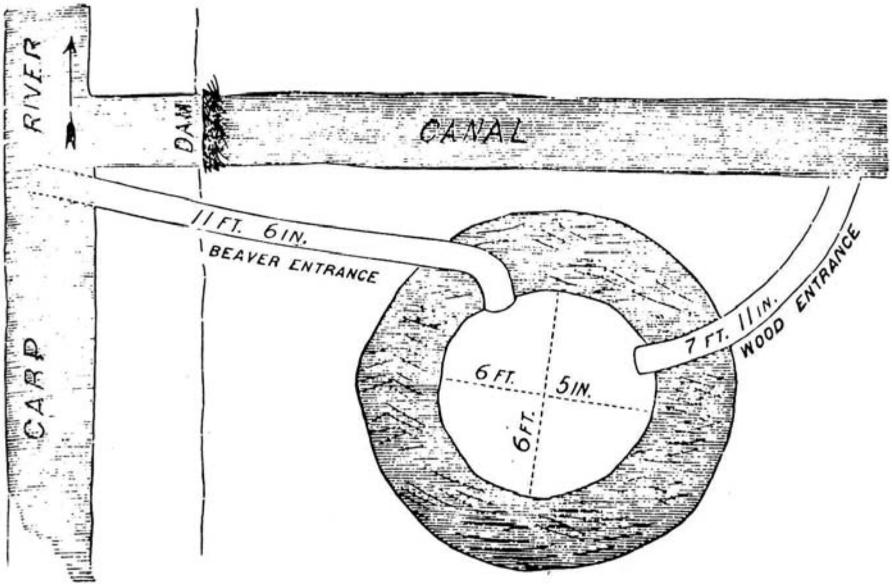
I endorse the view that the production of artefacts depends on a capacity for symbolic thought unique to *Homo sapiens*, a capacity that is based in the faculty of language; and I believe this has enormous implications for human evolution and human history. Amongst other things, it allows for innovation by deliberate invention rather than accidents of blind variation, for the transmission of design by teaching rather than imitative learning, hence for the active acquisition of culture rather than the passive absorption of tradition, which in turn is responsible for the cumulative or progressive growth of knowledge which is surely an undeniable and unique feature of the history of humankind. However—and this is no minor qualification—we should not be misled by these far-reaching consequences of the symbolic faculty into thinking that it underlies everything that we do. My contention, to the contrary, is that it underlies only a small though highly significant fraction of what we do, whereas for the most part human conduct does not differ all that substantially from the conduct of non-human animals.

Lewis Henry Morgan and the Engineering of the Beaver

It was the grandfather of modern cultural anthropology, E. B. Tylor, who in 1871 enunciated the now classic definition of culture as those ‘capabilities and habits acquired by man as a member of society’ (Tylor 1871, I, p. 1). Tylor’s definition has since been construed and misconstrued in countless ways; be it noted, however, that he always referred to culture in the singular rather than the plural, as a property not of particular local populations, but of mankind as a whole, and that in this sense it was used as a synonym for ‘civilization’ (Stocking 1968, pp. 73f.). For Tylor, therefore, culture referred to the progressive development of human knowledge in its various fields—of science, art, law, morality, and so on. Like most thinkers of his day, schooled in the philosophy of the enlightenment, Tylor believed that human beings, alone in the animal kingdom, were endowed with the quality of mind and that the greater or lesser ‘cultivation’ of this quality accounted tor the differences between peoples on a universal scale of degrees of civilization. The evolution of culture was therefore equated with the advance of mind, along uniform channels, within a constant bodily form. Only subsequently, following the publication of Darwin’s *The descent of man*, did Tylor’s views begin to shift towards the position that mental progress was a function of advance in inherited bodily form, and particularly in the form and complexity of the organ of thinking: the brain. This view, applied to the differences between human populations rather than between human beings and other animals, underlay the virulent racism of the late 19th century.

On the other side of the Atlantic rather similar ideas were being propounded by Lewis Henry Morgan, who ranks equally with Tylor as one of the founders of the discipline of anthropology as we know it today. Morgan's *Ancient society* (1963 [1877]) is very well known, though this owes a good deal to the historical accident that Marx and Engels, when they eventually came to read it, claimed to find in it the key to their materialist theory of history. In fact, Morgan's account of the evolution of society was anything but materialist, since it rested on the idea of the progressive cultivation of so-called 'germs of thought'. To find the source of that idea, we have to turn to an earlier and much less well-known work by Morgan, published in 1868 under the title *The American beaver and his works*. This splendid monograph on the behaviour and constructive abilities of the beaver is still regarded as an authoritative work on the subject. Morgan's interest in the beaver actually came about as a result of his involvement, as a director and stockholder, in a railroad company that was building a line to the iron-mining districts on the shores of Lake Superior. The line passed through virgin forest full of beavers, so that in connection with his duties for the company Morgan had ample opportunities to observe them at work. Like all other observers of this remarkable animal, he was enormously impressed by the industry and ingenuity they displayed in constructing their dams and lodges, which he described with painstaking precision (Fig. 1).

However, Morgan's beaver book is not only descriptive, tor it ends with a remarkable chapter in which he reflects on the intelligence and cognitive capacities of non-human animals, as they compare with those of humans. In this he took a line which, for its time, was quite unusual. The conventional view, yet to be shaken by Darwin's revelations in *The origin of species*, was that every species had been separately brought into being by God at the time of Creation, and had retained ever since its essential bodily form. Now Morgan was as convinced of this as anybody; and like so many of his contemporaries, he also believed that the human body was the place of abode for an incorporeal essence, known as 'mind' or 'spirit'—or in Morgan's own words 'the thinking principle'—whose cultivation amounted to the process of civilization. Unlike Tylor, however, Morgan felt that the thinking principle was *not* unique to humanity. To the contrary, he believed that the Creator had endowed *all* animal species, and not mankind alone, with a mind as well as a body. If anything convinced him of this, it was his observations of the technical accomplishments of the beaver.



Ground Plan of Lodge

Measurements

Diameter of chamber parallel with canal	6 feet 5 inches.
Transverse diameter	6 "
Height of chamber at centre	1 foot 9 inches.
Level of floor below ground	6 "
Height of floor above water in entrances	4 "

Figure 1. Ground plan and dimensions of one of the beaver lodges observed by Morgan. Reproduced from Morgan (1868, p. 153).

If civilized people differ from animals, Morgan surmised, the difference lies in the *degree* to which mind has developed, not in the presence of mind in humans as against its absence in non-human animals. For some reason the animals' mental progress has taken place at snail's pace compared with that of mankind, but this should not be taken to imply that animals have failed to make any progress at all since the days of the Creation. As for primitive humans, Morgan considered their degree of mental advance to be equivalent to, if not actually lower than, that of many animals. Indeed, in this respect he thought the beaver compared quite favourably with most so-called 'savages' (Fig. 2).

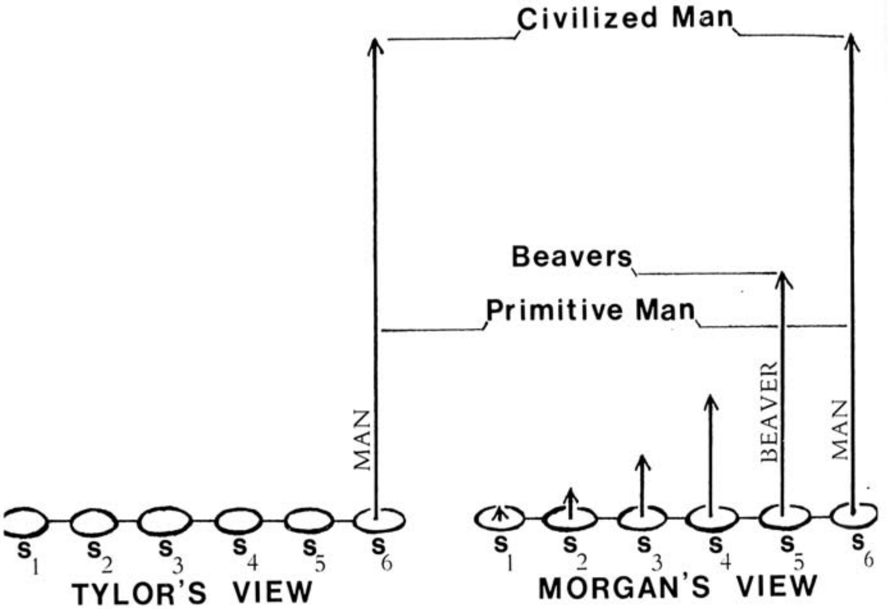


Figure 2. Tylor's and Morgan's views of mental progress. $S_1 - S_6$ are species linked in an ascending chain of being (S_6 is the human species). Vertical arrows represent the advance of mind, within a constant bodily frame. In Morgan's view both beavers and other non-human animals have minds of their own, which are also advancing, albeit slowly compared with the mind of man. However, beavers have already overtaken the most primitive men, as is shown by the ingenuity of their technical accomplishments.

I cannot refrain from citing a delightful passage from Morgan's book, in which he depicts the mental processes of the beaver at work:

> A beaver seeing a birch-tree full of spreading branches, which to his longing eyes seem quite desirable, may be supposed to say within himself: 'if I cut this tree through with my teeth it will fall, and then I can secure its limbs for my winter subsistence.' But it is necessary that he should carry his thinking beyond this stage, and ascertain whether it is sufficiently near to his pond, or to some canal connected therewith, to enable him to transport the limbs, when cut into lengths, to the vicinity of his lodge. (Morgan 1868, p. 262.)

According to Morgan, then, the beaver is a perfectly self-conscious, intentional agent; indeed, a consummate engineer, fully capable of planning out in his mind a complex sequence of instrumental operations *before* even beginning to put them into effect. 'When a beaver stands for a moment and looks upon his work', Morgan (1868, p. 256) went on, 'he shows himself capable of holding his thoughts before his beaver mind; in other words, he is conscious of his own mental processes'.

However, if the beaver thinks or, more to the point, if he *knows* what he thinks, why can he not tell us about it? Why is he incapable of communicating his thoughts to an observer? For Morgan the answer was perfectly plain: because he lacks the requisite speech-apparatus. In man this apparatus involves structures of the larynx, mouth and ears, which are built into the bodily equipment that all normal humans possess. By contrast, the beaver has the mind to think, but lacks the bodily equipment to broadcast his thoughts. The same also goes for all other animals which, even if not so intelligent as the beaver, still possess a thinking principle. For this reason, and not wishing to be disrespectful towards the animals, Morgan preferred to call them *mutes.*

As it happened, the weight of opinion soon swung against Morgan. A psychology strongly influenced by the ideas of Darwin sought to demonstrate precisely the opposite of what he had argued: namely that if humans differ from non-human animals in degree rather than kind, it is not because they all share a spiritual essence or thinking principle, but because the human mind itself should be seen as nothing more than the functioning of a bodily organ, the brain. In a sense, where Morgan had sought to upgrade animals, the Darwinians sought to downgrade man. It was against this strongly Darwinian current that the anthropology of the early 20th century had to fight once more for the recognition of a distinctively human essence, lying in what came to be called—in place of the ancient notion of spirit—the 'capacity for culture'.

One of the strongest champions of this position was A. L. Kroeber, and in a classic paper of 1917 on 'The Superorganic' we find him returning once more to the engineering of beavers:

> The beaver is a better architect than many a savage tribe. He fells larger trees, he drags them farther, he builds a closer house… But the essential point is not that after all a man can do more than a beaver, or a beaver as much as a man; it is that what a beaver accomplishes he does by one means, and a man by another. … Who would be so rash as to affirm that ten thousand generations of example would convert the beaver from what he is into a carpenter or a bricklayer—or, allowing for his physical deficiency in the lack of hands, into a planning engineer! (Kroeber 1952, p. 31.)

Kroeber's point about the planning engineer is this: the beaver *does not* and *cannot* construct an imaginary blueprint of his future accommodation, whereas this is something of which even the most 'primitive' human is capable. The human engineer constructs a plan in advance of the execution; the beaver lives merely to execute plans designed—in the absence of a designer—through the play of variation under natural selection.

Kroeber's remarks on the uniqueness of human works were by no means novel. They were, in fact, anticipated by Marx in a celebrated passage from the first volume of *Capital,* where he seeks to establish a form of labour peculiar to the human species:

> A spider carries on operations resembling those of the weaver, and many a human architect is put to shame by the skill with which a bee constructs her cell. But what from the very first distinguishes the most incompetent architect from the best of bees, is that the architect has built a cell in his head before he constructs it in wax. (Marx 1930, pp. 169f.)

That is to say, the human architect, who here denotes cultural man, carries a blueprint of the task to be performed, prior to its performance, whereas the non-human animal does not (Ingold 1986b, pp. 16–39). Thus, the Gothic vault, to borrow an example from Bock (1980, pp. 182f.), is literally man-made, in the sense that its presence may be explained 'by reference to the doings of persons'. Neither the web nor the hive could be said, in the same sense, to be 'spider-made' or 'bee-made'. However, human beings do not always act like architects or engineers, so that Marx's distinction could just as well be carried over into the domain of human conduct, to separate the novel products of intentional design from the habitual replication of traditional forms. This would be equivalent to Alexander's (1964, p. 36) contrast between 'selfconscious' and 'unselfconscious' processes, and corresponds to ours between the artificial and the innate.

Donald Griffin and the Language of Bees

There was a long period in the present century during which mainstream biology appeared content to share with cultural anthropology a view of non-human animals as virtually mindless automata. Insofar as anthropologists sought to emphasize the specifically human attribution of the symbolic imagination and its products, by drawing a contrast with the apparent disabilities of non-human animals, the rather negative characterization of the latter was only reinforced. Those who denied the absoluteness of the Rubicon were inclined, like Darwin, to doubt that there was anything more to human cognition than the functioning of the machinery of the brain, rather than to follow Morgan in suggesting that non-human animals might have autonomous faculties of reason and intellect such as we recognize in ourselves. However, in recent years there has been much renewed interest in animal thinking (Walker 1983), and many scholars are coming round to the idea that non-human animals do, indeed, have minds of their own, even if they do not express the idea in quite the same way as did Morgan. The result is a direct challenge both to the predominantly behaviourist stance of ethology and animal psychology, and to the prevailing anthropological conception of human uniqueness.

One of the most interesting and outspoken contributors to this area of debate has been Griffin (1976, 1984). He puts the question of animal consciousness in the following way: 'Do animals have any sort of mental awareness of probable future events, and do they make conscious choices with the intent to produce certain results?' (Griffin 1977, p. 31). Posing the question thus, he is really asking whether animals engage in rational deliberation, and whether they have a reflective self-awareness. In suspecting that they do, Griffin's position does not differ very much from what Morgan (1868, p. 271) asserted a century previously, that the animal 'sets the body in motion to execute a resolution previously reached by a process of reasoning'. The problem is: how are we to know whether the animal is thinking, and if it is, what its thoughts are? As Griffin (1984, p. 132) has to admit, I do not yet know of any way to ask a beaver whether it contemplates a pond as it drags mud and branches to the middle of a shallow stream'. If only we could find out, by what bounds would our understanding not only of the world of the beaver, but likewise of all other animal worlds, be increased!

The solution to the problem, for Griffin, lies in developing the appropriate mode of communication that would allow an animal lacking the specialized vocal-auditory apparatus used in human speech to deliver an introspective report on its experiences to a human investigator. This has prompted a great deal of experimentation with alternative channels to the vocal-auditory; notably the visual-gestural channel used in sign-language. There are many accounts, both specialized and popular, of attempts to engage gorillas and chimpanzees in conversation with their human investigators, using specially designed sign-languages (these are reviewed by Ristau & Robbins 1982). Various claims have been made regarding the ability of these primate cousins of ours to converse in language, but not one of these claims has remained unchallenged. In many cases of apparent language use, it actually turned out that the animal was merely emitting conditioned responses to covert stimuli of which even the investigator was unaware. This has come to be known as the 'Clever Hans' effect, after a celebrated horse of that name which was believed to be capable of impressive feats of arithmetic multiplication, until it was shown that he could only do it in the presence of someone who already knew the answers (Pfungst 1965)!

A further problem that all investigators into animal language have to face, and which none has satisfactorily resolved, is to explain why animals that are purportedly capable of linguistic communication when reared in a human environment do not manifest this capability under ‘natural’ conditions. Animals that converse with humans ought to be able to converse among themselves, so why do they not do so? Is it simply that, with small groups of individuals, familiar both with one another and with the country they inhabit, the need just does not arise (Marler 1977)? Do chimpanzees, say, living in their own little communities, have nothing to say to one another? Maybe, but then why should human beings, in similarly small, close-knit communities, have *so much* to say to one another? As George Steiner has suggested, it is in the intimacy of the small group, and not in the demands of communication with strangers and aliens, that language acquires its primary force and motivation. ‘We speak first to ourselves, then to those nearest us in kinship and locale. We turn only gradually to the outsider… (Steiner 1975, p. 231). So why should apes speak to outsiders before speaking to themselves? These questions, compounded with doubts about the validity of the experimental results, make me frankly sceptical of claims that non-human animals converse in language (see also Sebeok & Umiker-Sebeok 1980). I am fairly sure that the answer to whether they possess a linguistic faculty is ‘no’.

Let me return to what Griffin has to say on the question of animal awareness. If only we could find an appropriate medium for two-way communication between human and animal, he writes, we would at once have a ‘window’ into the animals’ minds, allowing us to eavesdrop on their mental processes (Griffin 1984, pp. 160–4). Advocating what he calls a ‘participatory approach’, Griffin likens the problem faced by the ethologist in establishing a dialogue across species boundaries with that faced by anthropologists in making contact with human beings of *other cultures*, and suggests that anthropological methods could well be extended to the study of *other species* (Griffin 1976, pp. 87–90).

Suppose, for example, that I wanted to enter into a dialogue with honeybees. I could not exactly *pretend* to be a bee: readers of Winnie-the-Pooh will know that deception is not easily practised on bees! Perhaps I could instead construct an exquisitely realistic model bee, equipped with radio controls, which I could place in the hive and manipulate at will from a safe distance. Now as is well known from the classic work of von Frisch (1950), honeybees possess a remarkable system for communicating to their co-workers the precise location of a food-source relative to the hive: they do this by repeatedly executing a figure-of-eight movement known as the waggle dance, whose orientation to the vertical indicates the direction of the food-source in relation to that of the Sun. I get my model bee, then, to execute a faultless waggle dance, and sure enough, the other bees are observed to respond in the appropriate fashion, by heading off to find food in the direction indicated by the dance. Yet I would still be doing something no bee has ever done, that is, executing a dance that corresponds to an image in my mind. Moreover, the image need not correspond to reality at all: I could perfectly well direct the bees on a wild-goose chase, towards a non-existent source.

In Figure 3 I portray two bees engaged in a dialogue. One has an image in his mind of a food-source, that may or may not exist in reality, and he is advising the other bee of its location, using the specialized 'sign language' of the waggle dance. For the other bee the message has a particular connotation—he thinks: so food is over there, I'll go and find it', and off he goes. Now this, of course, is precisely what does *not* happen; or rather, it could only happen between two human beings *pretending* to be bees in the way I have just suggested. We might imagine that in the supposed 'dialogue', one party is a human manipulating a model bee, the other a real bee. At once we can see that human and bee are not interchangeable partners in the dialogue between them. For the real bee the dance has no conceptual connotation at all: if the bee is the dancer, the dance is

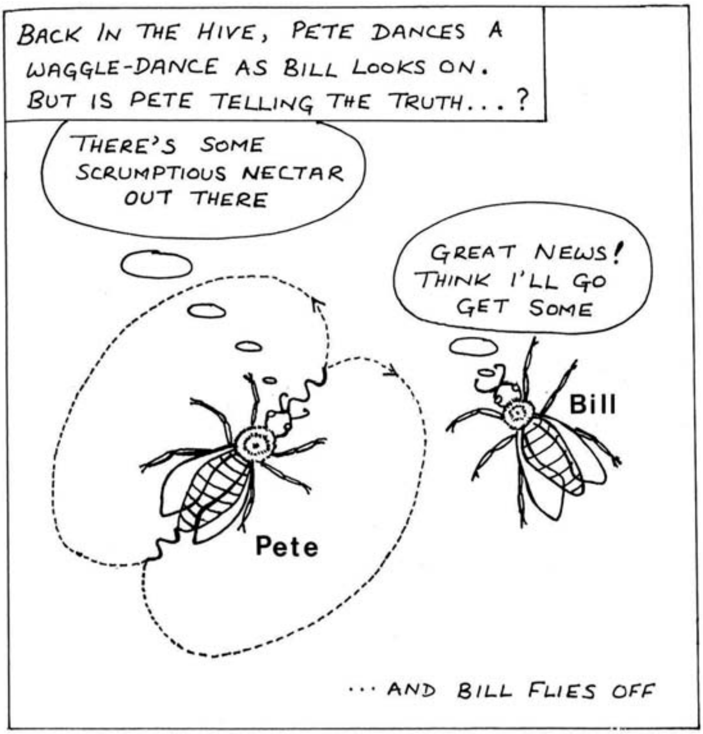


Figure 3. Two bees engaged in a dialogue.

'called up' by an internal organic state that was in turn induced by the preceding flight from a food source; in the absence of that source the dance behaviour will not be emitted, thus real bees cannot lie. And if the real bee is witness to the dance, it does not lead it to *conceive* of the presence of food at a particular place (a conception which it might or might not act upon, at its discretion), rather the dance has the direct effect of sending it off to the food source.

The dance, in short, is not a symbol that connotes an idea but a sign that commands action (Langer 1942, pp. 61–3). Hence there can be no *conversation* between humans and bees, or between bees, if by that we mean an intentional exchange of ideas between thinking subjects. Among themselves bees communicate, in that there is an exchange of information, but this information carries what Bronowski (1978, p. 43) has called 'the pre-programmed force of an instruction', and lacks any cognitive content. Since for that reason bees do not converse, participation in the full anthropological sense is out of the question. For the would-be participant observer there is simply nothing to participate in. Thus, although our fable of the bees may seem far-fetched, it does serve to establish a really fundamental proposition: *conversation across boundaries of culture is absolutely different from communication across boundaries of species.*

The sociologist Max Weber, writing around the turn of the century, wondered whether we could understand the thoughts and intentions of non-human animals. If we could, he argued that it would be possible, in theory, to formulate a sociology of the relations of humans to animals (Weber 1947, p. 104). While admitting the real difficulty of determining the subjective states of mind of animals, he did not altogether rule out the possibility of such a sociology. He even went so far as to surmise that our ability to understand what he called 'primitive men' might not be significantly greater than our ability to understand non-human animals! This is not a view that can still be seriously entertained today. Once more, the issue hinges on the phenomenon of language. There was a time, in the early days of anthropological and linguistic study, when it was thought that the languages of different peoples of the world could be ranked, alongside every other aspect of their culture, on a scale of development, with those of the West ranking highest on the scale. Primitive people, it was thought, had primitive languages, inadequate for expressing ideas of any great degree of complexity or abstraction. Nowadays we recognize that all languages of the world are equally developed, that there simply do not exist any 'primitive' languages. Nobody knows how language evolved; but assuming that it *did* evolve, in continuity with pre-human animal functions, there must long ago have been 'proto-humans' who spoke certain kinds of undeveloped 'proto-language'. Some linguists, such as Lenneberg (1967), have disputed the possibility of intermediate stages, but even if we infer their existence in the remote past, nothing remains of them in extant populations for us to study today. So, far from there being a minor difference between communing with non-human animals and communing with humans, or at least with ‘primitive’ humans, the gap is in tact a yawning one. As Talcott Parsons notes, in a critical comment on Weber’s text, Weber failed to take account of the fundamental fact that no non-human species has even a primitive form of language; whereas no human group is known without a fully developed one (in Weber 1947, p. 104, footnote 27).

The words of a language, unlike the components of a communication system like the honeybees’ dance, function primarily as symbols rather than signs. This means that their reference is to the internal world of concepts rather than the external world of objects. Attending to concepts, moreover, is what we call thinking. Thus language is, first and foremost, an *instrument of thought*, and not just a means for the outward expression or broadcasting of thoughts that are somehow already there, but which—in the absence of a broadcasting medium—would remain private, known only to the subject. Hence, the crucial difference between natives of another culture and animals of another species is this: the former possess a language which enables them to think, the latter do not. To grasp the natives’ thoughts we have but to learn their language, and as Hockett (1963) has pointed out, one of the specific features of human language is that speakers of one language can learn to speak and understand another. However, we cannot grasp the animals’ thoughts simply by learning and practising their communicatory mode, *because the animals have no thoughts*, as such, *to grasp.*

Morgan, it will be recalled, believed that the beaver had its thoughts, but lacked the means to communicate them—at least to humans. From this point of view the animal is *mute* in just the same way as is a human being who is deaf and dumb. Such an individual is still endowed with the faculties of reason and intellect, and can perfectly well express his or her thoughts if an alternative medium can be devised to overcome the physical impediment. If the fault lies in the mechanism of the vocal-auditory channel, we could replace it with a visual-gestural channel, as in the kinds of sign-language regularly used among people with handicaps of speech or hearing. Experimenters have tried using these same sign-languages, slightly adapted, in the attempt to strike up conversations with apes, but—as already noted—with rather limited success. For the truth is that no amount of searching for alternative channels of communication, or attempts to inculcate human-like communicative modes in animals, will reveal thoughts that just are not there. For my part I would argue that the normal non-human animal is the very opposite of the muted thinker, as originally portrayed by Morgan and reiterated today by Griffin and others. Throughout its waking life the animal continually emits a veritable profusion of signals, but without a reflexive linguistic facility it cannot isolate thoughts as objects of attention. That is, rather than thinking without communicating, the animal *communicates without thinking*; so that the signals it transmits correspond to bodily states and not to concepts.

Thinking, Feeling and Intending

Perhaps my emphasis on uniquely human intellectual faculties will be considered unduly anthropocentric. To counter this objection, I wish to stress two points. First let me ask of the reader: how many times in the recent past have you stopped to consider possible future outcomes before you acted? Not often, I should imagine. For the most part we no more think before we act than do other animals. As Whitehead (1938 [1926], p. 217) has remarked, 'from the moment of birth we are immersed in action, and can only fitfully guide it by taking thought'. That is, thought interrupts action, breaks it up into fragments; but by no means does it constantly *direct* action. The fact that we can think things out in advance does not imply that we always do. If we did, ordinary life would probably grind to a halt, since its demands would grossly overload our cognitive capacities. As everybody knows, it is impossible to think about everything at once. Consider the allegorical millipede who, when asked how he managed to move all his thousand legs, became paralysed and starved to death. Once he thought about it, he could not do it any more (Koestler 1969, p. 205). So much of what we learn consists of learning *not* to think about what we are doing, so that we can concentrate on other things (Medawar 1957, p. 138). We do not have to think how to ride a bicycle, and so can concentrate on the road ahead. A cyclist who does stop to think is inclined to fall off.

Secondly, I would again ask of the reader: those things that you did spontaneously, without premeditation, did you do them unconsciously? Surely not. You were, after all, responsible for your actions, and you experienced them as things that *you* did. So. by the same token, if we claim that animals do not think before they act, this is not to deny them consciousness or intentionality. It is entirely reasonable to suppose that a great many non-human animals (certainly including all vertebrates), whose nervous systems are organized on rather similar principles to our own, are both purposive and suffering beings, agents and patients. The question of animal *consciousness*, of doing and feeling, must therefore be separated from that of animal *thinking*. Griffin's major error is to have confused the two, though he is certainly on the right track in pointing out that the intentionality of action is indifferent to whether, or to what degree, the procedures for carrying it out are transmitted by instinct or learning; and hence that 'learning is not a reliable criterion of consciousness' (Griffin 1984, pp. 46f.

see Ingold 1986b, p. 27). Intuition may tell us that animals are conscious even when their manifest behaviour conforms to a genetically transmitted template, but we cannot infer from this that they necessarily think about what they feel and do.

Recall Griffin's criterion for judging the intentionality of animal actions—that they should be guided by mental images of desired future states. Is it not ironic that we should expect of an animal, as a condition of its being considered conscious and aware, that in all its activities it should proceed in accordance with plans already constructed through rational deliberation, when we ourselves do this but seldom in the course of practical, everyday life? To say that the animal is not conscious because (lacking language) it does not think before it acts, whilst admitting that we are conscious even though (despite language) we usually act before we think, is surely to apply double standards. Animals act as conscious, intentional agents, much as we do; that is, their actions are directed by *practical* consciousness. The difference is simply that we are able to isolate separate intentions from the stream of consciousness, to focus attention on them, and to articulate them in discourse. This corresponds to what Giddens (1979, pp. 24f.) calls the 'reflexive monitoring of conduct', and entails the operation of a *discursive* consciousness that rests upon the linguistic faculty and is uniquely human. Yet it is important to bear in mind that fully articulate, propositional language, such as is printed in books, is *not* the norm of human communication, but only the tip of an iceberg compared with the mass of spontaneous, non-verbal communication which we share with other animals (Midgley 1983, p. 88; Ch. 10, this book).

If it is granted that human conduct is purposive, even when it is not underwritten by a representation in the imagination of an end to be achieved, it must follow that advance planning is not a precondition for the intentionality of action. A distinction has therefore to be introduced, following Searle (1984, p. 65), 'between *prior intentions*, that is, intentions formed before the performance of an action, and *intentions in action*, which are the intentions we have while we are actually performing an action'. Conduct that is spontaneous, carried out without previous thought or reflection, but which we nevertheless experience as issuing from ourselves as agents, rather than being purely involuntary, carries intention in action, but is not motivated by prior intention. Clearly, these two kinds of intentionality correspond to the varieties of consciousness distinguished above, namely practical and discursive. If unplanned human action can be intentional in the former sense, the same must hold for the actions of non-human animals which, we suppose, lack the ability to plan.

To conclude, let me return to Marx's distinction between the works of the bee and the architect, and Kroeber's between those of the beaver and the planning engineer. Morgan in his time, and Griffin in ours, are suggesting that the distinction is not so absolute—that bees and beavers also plan things out, or envisage ends in advance of their realization. I do not think they do; but more than that, I do not think human beings do either, except intermittently, on those occasions when a novel situation demands a response that cannot be met from the existing stock-in-trade of habitual behaviour patterns. On such occasions, when—as Bock (1980, p. 185) puts it—'the hold of tradition on a people is loosened', behaviour gives way to activity, understood as 'the doing of something new and different'. For Bock, activity is to be distinguished from behaviour as the execution of solutions deliberately designed by the agents themselves to cope with previously unencountered eventualities. In these terms activity implies not just the execution, but the *authorship*, of design.

It is fruitless to enquire whether human beings are unique among animal species. Of course they are unique, having certain capabilities that all other animals lack. The same goes for every species, each of which is unique in its own particular way. *Homo sapiens* is distinguished not by consciousness, but by the extreme elaboration of certain cognitive mechanisms which may be taken to underly both language, as an instrument of planning, and the practical skills by which those plans are executed. Should these mechanisms, constituting the 'capacity for culture' on which anthropology sets such store, be regarded as an evolutionary specialization on a par with other specializations in the animal kingdom? Are we equipped for thinking as beavers are for building dams, or as spiders for spinning webs? Assuredly, if you are a human being, there is a certain adaptive advantage in being able to think, just as there is in being able to construct dams or webs if you are a beaver or a spider. Yet this specialization, since it permits the construction of design, rather than the construction of objects (dams or webs) according to a given design, has made us the most generalized and adaptable animals on Earth. We can, if we will, beat the beaver or the spider at its own game, turning to our own account solutions to technical problems already perfected elsewhere in nature through the long process of evolutionary adaptation (Steadman 1979, p. 159).

All in all, though humans differ but little from other animal species, no more than the latter differ from one another, that difference has mighty consequences for the world we inhabit, since it is a world that, to an ever greater extent, we have made for ourselves, and that confronts us as the artificial product of human activity.

References

Alexander, C.
1964 *Notes on the synthesis of form*. Cambridge, Massachusetts: Harvard University Press.

Beck, B. B.
1982 Chimpocentrism: bias in cognitive ethology. *Journal of Human Evolution* 11, 3–17.

Bock, K. E.
1980 *Human nature and history: a response to sociobiology*. New York: Columbia University Press.

Bonner, J. T.
1980 *The evolution of culture in animals*. Princeton, New Jersey: Princeton University Press.

Bronowski, J.
1978 *The origins of knowledge and imagination*. New Haven, Connecticut: Yale University Press.

Frisch, K. von
1950 *Bees: their vision, chemical sense and language*. Ithaca, New York: Cornell University Press.

Geertz, C.
1964 The transition to humanity. In: S. Tax (ed.), *Horizons of anthropology*, 37–48. Chicago, Illinois: Aldinc.

Giddens, A.
1979 *Central problems in social theory*. London: Macmillan.

Griffin, D. R.
1976 *The question of animal awareness: evolutionary continuity of mental experience*. New York: Rockefeller University Press.

Griffin, D. R.
1977 Expanding horizons in animal communication behaviour. In: T. A. Sebeok (ed.), *How animals communicate*, 26–32. Bloomington, Indiana: Indiana University Press.

Griffin, D. R.
1984 *Animal thinking*. Cambridge, Massachusetts: Harvard University Press.

Hallowell, A. I.
1962 The protocultural foundations of human adaptation. In: S. L. Washburn (ed.), *Social life of early man*, 236–55. London: Methuen.

Harlow, H. F.
1958 The evolution of learning. In: A. Roe and G. G. Simpson (eds.), *Behaviour and evolution*, 269–90. New Haven, Connecticut: Yale University Press.

Hockett, C. F.
1963 The problem of universals in language. In: J. H. Greenberg (ed.), *Universals of language*, 1–22. Cambridge, Massachusetts: MIT Press.

Holloway, R. L.
1969 Culture, a *human* domain. *Current Anthropology* 10, 395–412.

Ingold, T.
1986a *Evolution and social life*. Cambridge: Cambridge University Press.

Ingold, T.
1986b *The appropriation of nature: essays on human ecology and social relations*. Manchester: Manchester University Press.

Koestler, A.
1969 Beyond atomism and holism—the concept of the holon. In: A. Koestler and J. R. Smythies (eds.), *Beyond reductionism: new perspectives in the life sciences*, 192–232. London: Hutchinson.

Kroeber, A. L.
1952 *The nature of culture*. Chicago, Illinois: University of Chicago Press.

Kroeber, A. L. and C. Kluckhohn
1952 *Culture: a critical review of concepts and definitions*. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Vol. XLVII, No. 1. Cambridge, Massachusetts.

Langer, S. K.
1942 *Philosophy in a new key*. Cambridge, Massachusetts: Harvard University Press.

Lenneberg, E. H.
1967 *Biological foundations of language*. New York: Wiley.

Lumsden, C.J. and E. O. Wilson
1981 *Genes, mind and culture*. Cambridge, Massachusetts: Harvard University Press.

Marler, P.
1977 The evolution of communication. In: T. A. Sebeok (ed.), *How animals communicate*, 45–70. Bloomington, Indiana: Indiana University Press.

Marx, K.
1930 *Capital*, Vol. I (transl. E. and C. Paul from 4th German edition of *Das Kapital* (1890)]. London: Dent.

Medawar, P. B.
1957 *The uniqueness of the individual*. London: Methuen.

Midgley, M.
1983 *Animals and why they matter*. Harmondsworth: Penguin.

Morgan, L. H.
1868 *The American beaver and his works*. Philadelphia, Pennsylvania: Lippincott.

Morgan, L. H.
1963 [1877] *Ancient society*, E. B. Leacock (ed.), Cleveland, Ohio: World Publishing.

Pfungst, O.
1965 *Clever Hans (The horse of Mr. von Osten)*, R. Rosenthal (ed.), New York: Holt, Rinehart& Winston.

Reed, E. S.
1982 Darwin's earthworms: a case study in evolutionary psychology. *Behaviourism* 10, 165–85.

Ristau, C. A. and D. Robbins
1982 Language in the great apes: a critical review. *Advances in the Study of Behaviour* 12, 142–225.

Searle, J.
1984 *Minds, brains and science*. London: British Broadcasting Corporation.

Sebeok, T. A. and J. Umiker-Sebeok (eds.)
1980 *Speaking of apes: a critical anthology of two-way communication with man*. New York: Plenum Press.

Steadman, P.
1979 *The evolution of designs: biological analogy in architecture and the applied arts*. Cambridge: Cambridge University Press.

Steiner, G.
1975 *After Babel: aspects of language and translation*. London: Oxford University Press.

Stocking, G. W.
1968 *Race, culture and evolution*. New York: Free Press.

Thorpe, W. H.
1961 *Bird-song: the biology of vocal comunication and expression in birds*. Cambridge: Cambridge University Press.

Tylor, E. B.
1871 *Primitive culture, 2* vols. London: John Murray.

Walker, S.
1983 *Animal thought*. London: Routledge & Regan Paul.

Weber, M.
1947 *The theory of social and economic organization*, T. Parsons (ed.), New York: Free Press.

Whitehead, A. N.
1938 [1926] *Science and the modern world*. Harmondsworth: Penguin.

The Biosemiotics and Phylogenesis of Culture*

Dominique Lestel

The question of the relationship between the social sciences and ethology has bedevilled both fields ever since the publication of Espinas's (1935) thesis on animal societies. True, the attitude of some of its most ardent advocates, like the ethologist Wilson (1975), does nothing to reassure social scientists,[1] who feel, unfortunately often with some justification, that their relations with animal behaviourists may lead to an overbiologization of the representations of social phenomena. With the recent debate on animal cultures, the relevance of comparisons between animal and human societies is once again in the forefront. One can therefore only express surprise at the indifference shown, in this context, to the status of communications in animal cultures. Such marginalization is all the more astonishing since many social scientists justify their refusal to recognize the slightest relevance of ethology for their own disciplines by the presence of language in humans and its absence in animals. Another approach to animal cultures might consider that they constitute societies in which the more central communication is to the society, the greater the individual member's gradient of freedom, and that the most remarkable feature of this complexification is the emergence of an animal subject which prefigures the possibility of a human subject.

Animal Cultures

Animal behaviour is still massively described as if one were talking about the actions of more or less sophisticated automatons. A small number of ethologists, however, are sensitive to the behavioural innovations which appear in animal societies and to the procedures by means of which the originally individual in-

---

* From: Lestel, Dominique 2002. The biosemiotics and phylogenesis of culture *Social Science Information* 41(1): 35–68. Translated from the French by Nora Scott. Reproduced with permission of SAGE.

[1] Wilson's notion of "consilience" (Wilson, 1998) in no way alters his earlier positions. For E. O. Wilson, the reductionist approach is always the most fruitful.

novations are transmitted to the other members of the group. Such phenomena had already been observed well before people began talking about culture in chimpanzees. Fisher and Hinde (1949; Hinde and Fisher, 1951) reported the curious behaviour of British tits, which puncture the foil tops on milk-bottles left on the doorstep in the morning in order to drink the milk. In particular, these authors showed the novelty of this behaviour, which had appeared at a given time, and that, with the passing years, it has tended to spread throughout the British Isles and Ireland. Shortly afterwards, Imanishi (1952) used the term "adjustive behaviours" to describe learned behaviours in the macaques on Koshima Peninsula, and he explicitly suggested that these were cultural in nature. In the 1950s, the Japanese organized a study of these macaques. They observed their behaviour and devised experiments to test these monkeys' aptitude for innovation and their capacity to acquire a new behaviour by imitation. Kawai (1965) used the term "preculture", while Kawamura (1959) spoke of a "subculture". The latter suggested, more particularly, that each new-born monkey must acquire a "fundamental attitude" which is governed by the social organization of the band, and that this is the most basic skill the infant must acquire. The Japanese studies began to attract attention in the West in 1957. This particularly Japanese orientation can be explained in part by Buddhism, which emphasizes the affinity between man and animals, and by the alleged group behaviour of the Japanese which leads them to favour small groups and personal relationships. And indeed, Japanese primatologists focus on interactions between well-defined animals (Kitahara-Frisch, 1991). I feel personally that the fact that the Japanese primatologists were originally anthropologists, and not biologists or psychologists, had a lot to do with their "ethnographic" approach to the macaque societies, and that we constantly underrate the disastrous influence behavioural psychology has had in the West.

Nevertheless, in the early 1970s Struhsaker and Hunkeler (1971), Nishida (1973) and Van Lawick-Goodall (1973) compared the behaviours of wild primates living in different regions. Van Lawick-Goodall, in particular, defended the idea that wild chimpanzee communities constituted genuine cultural communities, basing her argument on Kummer's (1971) definition of culture, and stressing the privileged relationship between infant and mother. The study of animal techniques made it possible to give a more detailed account of the large behavioural variations among common chimpanzees (*Pan troglodytes*) in same-species groups living in the wild. McGrew and Tutin (1978), who undertook a systematic survey of these variations, suggested that chimpanzees might have culture-based social organizations, whose study could be described literally as animal ethnology. Since then, certain behaviours have been the object of especially meticulous comparisons: termite fishing, nut-cracking, hunting techniques, hand-clasping grooming, foraging for oil palms, etc. Twenty years on, Whiten et al. (1999) listed 44 behaviours found in common chimpanzees which exhibit "cultural" variations.

The 1990s saw the rise of studies dealing with behavioural variations in non-primates, particularly in certain birds or marine mammals, but also in more surprising animals, like Atta ants (Müller et al., 1998). Ornithologists have long reported the existence of "dialects" in bird song, but they have never dwelled on the cultural dimension of this behaviour. Conversely, when Hunt (1996) showed that crows in New Caledonia (*Corvus moneduldoides*) used two kinds of curved probes to capture prey and that these are made according to norms specific to a given wild group, norms determined neither by the nature of the materials nor by the techniques used to make them, he did not hesitate to speak of "crow cultures" and to compare these to "chimpanzee cultures". Yet it is the marine mammal data which most closely resemble the material on "primate cultures", in spite of our meagre knowledge of these astonishing animals; one has only to remember that, though there are 80 known species of marine mammals, only four have begun to be studied seriously: the classical dolphin (*Tursiops truncatus*), the killer whale (*Orcinus orca*), the spermwhale (*Physeter macrocephalus*) and the humpbacked whale (*Megaptera novaeangliae*). Without going into detail, I will recall a few of their behaviours which have been described as cultural: the songs of the humpbacked whale, which exhibit astonishing innovations and speed of diffusion; the incredible diversity of the foraging techniques found among humpbacked and killer whales; the similarity of behaviours specific to a mother and her offspring migrating to their reproduction grounds in humpbacked and white whales; and the utilization of sponges in the dolphins of Shark Bay, in Australia (Ford et al., 1994; Smolker et al., 1997).

Is the Idea of Animal Cultures Coherent?

Are the behavioural variations revealed through meticulous ethological fieldwork enough to establish the existence of animal cultures? The idea of animals like chimpanzees having a culture creates difficulties of considerable importance for all social scientists, but these leave primatologists and ethologists strangely indifferent.

- Ethologists stress the multiplicity of behavioural differences in certain animal species, and horizontal (between adults) or vertical (between generations) transmission of the innovations engendered by a few individuals.
- Ethologists, in particular the primatologists we are discussing, considered from the outset that they were observing animal "cultures" which could fit-

tingly be compared with human cultures. Nevertheless this remains a very special kind of comparison, in the sense that one first needs to establish the legitimacy of speaking of "culture" in the case of animals, based on features which are necessary and sufficient to the definition of any culture.

- Those who have tackled the question constantly assimilate their conviction that they are dealing with "animal cultures" to the necessity of using an ethnographic method to describe these animal cultures.
- There is a surprising lack of attention paid to communication processes in animal societies qualified as "cultures", with the sole exception of the debates on the ability or inability to transmit new behaviours. In addition, a crucial question has been all but ignored: if animals do not possess language, can they be subjects, and if not, can there be cultures in societies that do not have subjects?

There is one exception to the lack of attention paid to communications, and it concerns those communications required for social learning.[2] There may be two explanations for this indifference. The first paradoxically concerns the small amount of reliable material available on animal communication in the most complex societies, those usually designated as "cultures". The second goes back to an insufficiently problematized philosophical heritage for which language is basically that skill which divides humans from animals; in this still widely shared view, non-speaking animals can of necessity have only very primitive communications. Language has thus been regarded as an essential condition of human cultures, as opposed to animal "cultures". For instance, Washburn and Benedict devoted an article to the subject in 1979. Earlier, Holloway (1969) wrote a long piece in which he defended the idea that only humans have cultures. Another anthropologist, Bohannan (1973), argued, on the contrary, that it was time anthropologists took an interest in animal cultures, but his essay did not obtain the readership that his bold ideas deserved. And when sociologists set out to found a single science which would explain the sociability of both ant societies and human societies, they encountered understandable reticence on the part of social scientists. In undertaking to explain human societies by *causes*, in rejecting an understanding based on *reasons*, and in holding the language dimension of human societies to be totally negligible, sociobiologists were tampering with a central pillar of the social sciences. It was this aspect,

---

[2] This is why several experiments are discussed when the idea of animal culture comes up. But these are discussed from a classical experimental standpoint which ultimately saps these studies of all substance by managing to gloss over the social situation under study, namely the relations between the animals being tested and the humans testing them.

more than the genetic terms in which the ideas were couched, which made the defensive reactions so legitimate. The sociobiologists' approach consisted in first of all denying the reality of a specifically cultural dimension in human societies in order to assimilate them to mechanisms that had been observed in animal societies. However, evoking the reasons for a behaviour rather than its causes is tantamount to taking a semiotic stand.

In the following pages I will attempt to show that animal communications are much more complex than is usually believed, that the semiotic dimension of animal cultures has been totally neglected by ethologists, whereas it establishes their relevance even more solidly, and that in return the question of animal cultures is capable of transforming biosemiotics by focusing on the social dimension of a great many semiotic phenomena occurring in nature, by showing the necessity of taking interspecific communications into account so as to develop a genuine phylogenesis of meaning, and by looking more closely at the ontological status of the organisms involved in these processes.

Language and Animal Communications

Unlike the work on animal cultures, the recent studies on the evolution of intelligence and the emergence of human skills consider language to be of fundamental importance. Donald (1991) defends the thesis that not only do humans have a bigger brain, they have new systems for representing reality, in particular through language. This cognitive innovation allowed humans to move from a mimetic culture to a mythic culture through the new narrative capacities offered by language. Mithen (1996) advances a scenario in which the human mind developed in three stages. In the first, he suggests, the mind operated with a fairly rudimentary general intelligence; in a second stage, the human mind developed specialized cognitive modules, which worked better than the former general intelligence but did not communicate with each other; finally, in a third stage, human intelligence became considerably more "fluid" and could link up the different modules. This major transformation was made possible by language, and its appearance is indisputably one of the major events in the natural history of intelligence, even if it is hard to evaluate its true uniqueness and the importance of its role, which has always been assessed in a discontinuist perspective, although the empirical arguments do not really justify the privileged position this thesis enjoys. In spite of their differences, the two theses agree that the appearance of language constituted a fundamental break: the emergence of human cultures, in other words, of cultures, period. But just how great is the difference between animal communications and language?

After several decades of research on animal communications, it is still hard to draw up an exhaustive table of the differences between language and animal communications. It is however possible to give an appreciably more complex account of the latter than the usual representations provide. In particular, some of the purportedly distinctive features of human language can be observed in animal communications:

- While animals do not transmit messages, certain species have been found to have traditions of the way messages are to be transmitted. Take, for instance, the vervet monkey, whose appropriate use of alarm calls and the responses they elicit is traditional (Seyfarth and Cheney, 1997). More generally, in many animals, dialects correspond to local, acquired characteristics of the modes of communication which are passed on from one generation to the next (Grant and Grant, 1996).
- Examples of meta-communications in animals abound, although they are not necessarily phatic. Closely related female squirrel monkeys (*Saimiri sciureus*) exchange "chucks" (Newman and Symmes, 1982); are these "comments" on the social relation they are engaged in, as has been suggested? Bateson (1977) considers that the play signals used by certain animals fall into this category[3] as does the sharing of song patterns by birds which have a close social relationship. One also sees a meta-communication when an adult animal "corrects" a juvenile for expressing itself "incorrectly", for example when a young vervet gives an alarm call in an inappropriate context (Seyfarth and Cheney, 1980).
- Animals' capacity for innovation is much greater than is generally believed. Van Lawick-Goodall (1968) described transitory fashions in the manipulation of vegetable matter. Likewise Nishida (1980) reported the appearance in Mahale of "leaf-clipping", a behaviour expressing frustration, which is found nowhere else. But the most continuous variation is found in the songs of birds and whales. While language makes it possible to develop individual forms of narrativity, it is not in itself a necessary condition. As soon as there is the possibility of mimicry, there is a potential for narrativity. An animal at play is already telling a story, as is one which deceives a competitor. Machiavellian intelligence itself is full of stories.
- The reference to messages is less inflexible than is often believed. A certain number of animals are capable of giving a different meaning to what they express (in the case of play), but they are also capable of manipulating the meaning of their expressions by deliberately referring to a situation or a phenomenon that does not exist. The literature on deceit and cunning has grown

---

[3] When an animal plays, it also "tells" its partner: "this is a game".

considerably since Byrne and Whiten's (1988) article on Machiavellian intelligence in primates. Most cases deal with misleading behaviours, but there are also misleading messages. Blackbirds (*Turdus merula*) and song thrushes (*Turdus philomelos*) give alarm calls even when the announced predators are not there (Thielke and Thielke, 1964). The same behaviour can also be seen in chickadees (Moller, 1988) and in some Amazonian species (*Lanio versicolor* and *Thamnomanes schistogynus*) (Munn, 1986).

- It is hard to be too quick in affirming that a double articulation is in itself a feature of language. Simple syntaxes have been reported in the cotton-top tamarin (*Saguinus oedipus*) (Cleveland and Snowdon, 1982); marmosets (*Cebus pygmaea*) (Pola and Snowdon, 1975); capuchins (*Cebus olivaceus*) (Robinson, 1984); and in rhesus monkeys (Hauser and Fowler, 1991). Black-capped chickadees even structure their songs using an authentic (and primitive) generative grammar—these are the only non-human animals known to possess this characteristic (Hailman et al., 1985, 1987; Hailman and Ficken, 1987). Yet these chickadees are not capable of generating an infinite number of combinations, and nothing suggests that each separate structure has a distinct meaning. Combination of individual "calls" into phrases which retain the meaning of the separate components is found however in marmosets and capuchins. Certain calls thus have an ABC structure, but it is still hard to say if the CBA structure is semantically different or if the monkeys interpret it in the same way. It should also be noted that sign languages, now recognized as genuine languages, do not possess this double structure.
- Dialogue appears in animal communications. Haldane (1953) reported that bees interact in deciding where to locate a new colony. All the ritual duets described in ethology can thus be termed dialogues, even if they are invariable and remain highly repetitive. Songbirds can also learn the dialect of another population or the song of another species with which they are in contact (Mundiger, 1970; Nowicki, 1989; Hausberger et al., 1995). But these phenomena are not limited to birds. Mothers of rhesus macaques or Japanese macaques that have been raised together respond to the calls of their adopted children; vervets are attuned to the alarm calls of *Sprea superbus* (Hauser, 1988), and male and female white-cheeked gibbons co-ordinate their singing in an elaborate fashion (Deputte, 1982).

The case of honey-bee (*Apis mellifera*) dances has a special place in the literature. One of the best specialists, James Gould, still considers that their dances can be regarded as a genuine language—referring to flowers that are removed in space and time—whose structure is based on arbitrary conventions (Gould and Gould, 1988). The direction of the sun, for instance, is associated with "straight up" in a by no means obligatory way. For *Apis mellifera carnica*, a distance of 45 metres is represented by waggling the abdomen. The same behaviour, however, corresponds to a distance of 20 metres for *A.m. ligustica* and to 12 metres for *A.m. lamarkii*. The arbitrariness of these conventions is a species arbitrariness. The symbolic dimension is now rarely contested. Gould (1974, 1975a, 1975b) has made scout bees "lie" about the location of the desired food by experimentally manipulating their environment.[4] Other species too have the potential to use symbolic communications. Boesch (1991), for example, has described common chimpanzees (*Pan troglodytes*) in the wild using[5] a curious mode of communication which consisted of drumming on trees, and Savage-Rumbaugh et al. (1996) gave a lengthy explanation of the reasons which led them to think that wild bonobos (*Pan paniscus*) in Zaire left signs along the paths they had taken and indicated their direction so as to find their way back in the evening.

A Few Difficulties Encountered in Characterizing the Complexity of Animal Communications

It is hard to investigate the differences and similarities between animal communications and language from the simple standpoint of continuity or discontinuity. It is not trivial to find a feature of human language which is not found to some degree in the communications of at least one animal species, even though language remains the only system of communication which possesses all of these features at once (Snowdon, 1999). Yet this kind of comparison is not really satisfying, as it takes language too exclusively as the standard for all other semiotic systems. Language and animal communications differ in a host of significant ways, some of which are altogether unexpected, such as the physical duration of the vocal expressions in animals. Birds rarely sing sequences lasting longer than 15 seconds. And these are rare. Most birds do not exceed six seconds, and the average hovers around three seconds, as in most parrots. Only humans and humpbacked whales have non-repeated sequences which last longer

---

[4] The bees recruited by the scout go to the spot erroneously indicated by the dance and not to where the food actually is. Schricker (1974) poisoned some scout bees with parathion, thus causing them to overestimate the distance between the hive and the food source, and the recruits showed a preference for going to the spot designated by the scouts and not to where the food source really was.

[5] I use the past because it was curiously enough a mode of communication limited in time and space, and in addition restricted to the big males.

(Hartshorne, 1973). A few examples of the problems encountered will give a reasonable idea of the nature of the difficulties involved.

Bateson characterized animal communication by its inability to express *negation*. Although this is an interesting hypothesis, it is far from proven. Counterexamples abound, even in animals living in the wild: chimpanzees who inhibit the noise they make (silent raids) and impose this silence on the rest of the band; females who reject male advances; proscriptive rules in baboons, etc. Furthermore, the notion of negation as employed by Bateson is none too clear. Even humans, in many situations, do not openly express negation, but they make it understood. Is an animal which does not do what the other wants expressing a negation? When a child eats something other than what he/she is asked to eat, is he/she expressing a negation? This outlook sheds a new light on the recent debates in ethology and comparative psychology on deceit and cunning. When a young baboon hides from a third party in order to do something the latter forbids (for instance hiding behind a rock to have itself groomed by a forbidden female), is it not already engaged in expressing a negation? When a chimpanzee is surprised beside a forbidden female by the dominant male and hides his erect penis which expresses his desire, cannot this behaviour be interpreted in terms of negation? Globally three types of negation need to be distinguished:

(a) a *praxeological negation*, expressed with regard to an action (I don't want to follow you); (b) an *epistemic negation* bearing on knowledge expressed by the other (this isn't true, this isn't a relevant piece of information, etc.); (c) a *statutory negation*, bearing on status within the group. While status and actions are negotiable in animals, there is visibly less leeway when it comes to knowledge. Bateson himself provides a nice example in the way he describes aggressive games, which at the same time say "this is a game and not an aggression".

As a rule, we do not have immediate access to animal communications, and these still hold a number of surprises in store, particularly from the conceptual standpoint. The space of animal communications is as yet largely virgin territory, as has been shown by Marler (1977), who considers that play is the closest equivalent to human language, Dennett (1987), who raises the question of the absence of secrecy in vervet monkeys, and Bateson (1980), who describes the use of metaphor by a wolf in Chicago's Brookield zoo. The latter is a particularly revealing case. The British researcher saw the pack leader walk over to his rival, who was copulating with a female to which he did not normally have access; but instead of tearing the upstart to pieces, he merely forced his head down four times before walking away. Bateson interprets this behaviour as a metaphorical action by which the leader of the pack expressed the fact that he was an adult and an elder, and the other was only a youngster. The sentiment that the area of animal communications is not necessarily being addressed in the best way is not recent: 50 years ago, Haldane (1953), far from immediately focusing on the differences and similarities between the "language" of bees and human language, asked himself what distinguishes and what links an action and a communication. In the hive, bees undeniably make movements which elicit responses in other bees; but the first are not necessarily communicating information about the new food source. Some of these movements can be regarded as ways of expressing the next action. Haldane came to the logical conclusion that the distinction between communication and action is not as clear as it had seemed. Not only can animals express movements indicating intention, they can also reply to them. The more ritualized the movements, the easier it is to reply. Haldane therefore suggested that, rather than being the communication of a message, the bee dance was a highly ritualized movement of intention which took place before leaving the hive and which caused any other bee to leave in a like manner. The honey-bee's dance can thus be interpreted as the prediction of its future movements rather than the description of its past movements.[6] Haldane considered that the bee dances were interesting because of their "temporal ambiguity", which makes them both prophecies and stories.

Generally speaking, our intuitions about animal communication are often erroneous or approximate. Mammals provide a good example of this handicap. Dolphins in particular raised numerous hopes in the 1960s. Many cetologists thought at the time that dolphins, which are without a doubt exceptionally intelligent, must possess a very complex system of communication.[7] However, if a "dolphin language" does exist, it has yet to be discovered. Alternatively, dolphin identity whistles have recently been the object of longitudinal studies which have revealed their variety and complexity (McCowan and Reiss, 1995).

---

6. In particular, Haldane draws an interesting conclusion from his interpretation, when he evokes a distinctive feature of human language which may have permitted the shift from *evocative discourse*, which points to the future, to *descriptive discourse*, which talks about the past. Humans differ from the other animals by the way they relate to time, and the communications between humans should be judged with this in mind.
7. Bateson (1980) represented such hopes. In the 1960s, he expressed the idea that, while dolphins certainly do not have the same kind of language as humans, their system of communication must still be highly sophisticated. He characterized animal communication as an analogue communication which deals with relations, and language as a digital communication which deals more with things. Dolphins were in a class of their own, having a digital communication which deals with relations.

Evolution of Meaning

Contrary to what Griffin (1981) thought, the study of animal communications does not so much open a window onto the animal mind as take into consideration an essential dimension of animal social behaviour. Communication is part and parcel of the animal world; it does not necessarily refer to something internal or external to the animal, even though that is the more or less explicit position of the vast majority of researchers working on animal communications.[8] Three features of the ethnologists' approaches point in this direction: (1) they are looking primarily for the "message" conveyed by these communications; (2) they privilege one specific modality of expression in the animal, as though it were using a language-substitute, and pay only vague attention to the fundamental multimodality of all animal communications; (3) they do not look at the status of the locutors doing the communicating. Are animals genuine subjects, as humans are in language, or are they mere "relays" and, if so, between what and what?

Other features, too, may need to be brought in at any moment, as we have seen with as creative a researcher as Gregory Bateson, whose "bottom up" approach must be distinguished from the "top down" method of Thomas Sebeok, who coined the term "zoo-semiotics" in 1963. Sebeok is a somewhat unusual linguist who began working in biology and specialized in genetics by acquiring what he calls a "biological way of thinking" before ultimately turning to the mechanisms of language. Sebeok saw his change of direction as a shift from studying the *genetic code* to studying the *verbal code*, and because of this has from the start been sensitized to the question of signs emitted by living beings—and his interest in animal communications has never flagged. Sebeok's writings on animal communications remain an undeniably rich source of ideas. For instance, he suggested in his first article on zoosemiotics that communication by means of odours is a form of *writing* rather than of speech (Sebeok, 1962), and that it is an excellent means of communicating over time (1963). He argued that the arbitrariness of a code is a logical consequence of the digital structure of codes (Sebeok, 1962). He discussed the idea that all of the components of the honey-bee dance can be found in other animals, but that only the honey bee has brought them all together (Sebeok, 1963); and that the behaviour of honey bees resembles that of an analogue computer (which can express quantities and intensities in a continuous manner) and not that of a digital computer (which works by yes or no) (Sebeok, 1963).

---

[8] Hauser (1996) is representative of this position.

After all, Sebeok started from a general theory of animal communication modelled on the cybernetic theories so popular in the 1960s and which continue to be the backbone of work on animal communications. The American semiotician lays particular stress on the "message" conveyed in the communication process, on the way it is encoded by a sender and decoded by a receiver, and on the physical means of communication used.

Another approach to communication, which grew up in the 1990s, places less emphasis on the idea of message. Instead, it contends that animal communications are part of a wider *semiosphere*[9] which can succinctly be described as that of the processes by which living beings generate and process *meaning*—a notion foreign to Sebeok's original technical culture. In this version of biosemiotics, living beings interact not as mechanical entities but as messages. This suggested a semiotic paradigm for biology which considers that the biological form should be understood first and foremost as a sign.

Von Uexküll (1982) is regarded as the father of this approach since he is the one who first introduced the relevance of the notion of meaning into biology. Not being familiar with semiotics, he took his metaphors from music; his central idea was that the processing of meaning by living organisms should be regarded as the chief problem of biology. Later, after the discovery of DNA and the spectacular development of molecular biology, von Uexküll's dream of a biology of meaning has retained the interest of very few, although it has not disappeared altogether. This is attested by the work of such as Tembrock (1971), who drew on linguistics for his classification of types of communication in biology, and Florkin (1974), who applied Saussurean linguistics to the molecular processes of the cell. Von Uexküll himself never mentioned the notion of biosemiotics, and Kull (1999a) considers that the term first appeared in a lecture given by Friedrich von Rotschild in 1961, but not published until 1989. Finally, in the early 1990s, Sebeok and Umiker-Sebeok (1992) brought out the first collection of articles devoted to the new field.

Today's biosemiotic approaches present the advantage of placing the question of meaning in a broader evolutionist perspective which avoids the necessity of a miraculous break, and then the sudden appearance of meaning. On the contrary, meaning is seen as co-present with living beings from the beginning; it is the modalities of expression which change and grow in complexity.[10] In this sense, animal communications should be approached as the continuation of a

---

[9] The Russian semiotician, Y. Lotman, was the first to use the term (Kull, 1999c).

[10] Increased complexity in the way a living being processes meaning does not imply any finality. A direction of development can be determined after the fact which does not depend on its development being determined in any way.

phenomenon that is consubstantial with life itself. Indeed, Sebeok explicitly considers that the zoosemiotics he so enthusiastically promotes is rooted in a broader sphere of semiotics. Yet his biosemiotics never addresses the question of animal cultures. Among the objectives of this new domain, Kull (1999b) regards finding out how an organism becomes a subject as one of the major goals of biosemiotics. Yet this approach is incapable of conceptualizing this dimension of its undertaking because it sees itself primarily as a branch of theoretical biology and holds itself aloof from the social sciences, despite the Sebeok exception.

Ingold (1989), also unfamiliar with biosemiotics, is more productive in this perspective because he is an anthropologist who openly defends the need to rethink the framework of biology from within, so as to develop a genuine interface between anthropology and biology. After having observed that a biology originally and explicitly built on the opposition between humans and animals, and not only on the opposition between the living and the non-living, is incapable of thinking the relationship between the two, Ingold argues that it is important to replace the neo-Darwinian paradigm, which reasons in terms of populations, with an evolutionary approach which instead reasons in terms of relations, and which identifies the organism or the person as the true creative agent at the origin of the evolutionary process. He suggests introducing a genuine anthropology of personhood into biology. In addition to neglecting the organism, neo-Darwinian biology also underrates the importance of its social life. Ingold defines an organism as the organized and open-ended embodiment of a life process. The stages by which one becomes a person are superimposed on those by which one becomes an organism. From this standpoint, a human being is not at once an organism and a person, as Radcliffe-Brown wrote (1952), but "simply" an organism, in the full complexity of the notion. The person appears with the development of the organism, and his or her sociability is consequently characterized as the quality of the relations resulting from the consubstantial relationship between consciousness and intersubjectivity, whereas neo-Darwinian sociability is a property which lies outside the organism and adds to what it is from outside (through its environment) or from inside (through its genes). What matters here is that the appearance of the "person" lends an added dimension to the processing of meaning in the living world.

Can Animals be Subjects?

Ingold defends the idea that an animal can be a person. I prefer to speak of "subjects", which has a more psychological and less juridical connotation. The question of whether animals can be considered to be subjects in animal societies is never explicitly raised by most ethologists, who proceed as though this were not the case (and therefore do not question the status of each animal within its own society). Only a small minority look at the animals they observe as though they were subjects (Van Lawick-Goodall 1973; Boesch 1991; Strum 1987, etc.), but they do not actually discuss the legitimacy of this approach or attempt to consider the status of the observed animals in a satisfactory manner. Yet the question of the animal as subject concerns not only ethologists working on wild life, but ethnologists as well. Determining what status to attribute to the "speakers" involved in animal communications is central to the debate on animal cultures, even if the problem has never been posed in these terms. One of the important reasons anthropologists hesitate to accept the idea that animal societies can be cultures stems from their implicit conviction that a culture is a society whose members are subjects. Do animals fill the bill? Philippe Descola repeatedly emphasizes that this is the case in native American cultures, whether in South or North America, and that the animal has precisely this status. He would no doubt be followed on this point by many of his colleagues who study human cultures in other continents. But the question which interests me is not that. The problem is not whether some cultures have *already* regarded animals as subjects, but whether it makes sense to defend such a position in the context of *our own* cultures as well as in the context of the recent development of the animal sciences. In this regard, it is odd to realize that McGrew (1992) speaks of chimpanzees as though they were sophisticated automatons.

And yet the idea that animals might be subjects is not new, even among zoologists. It was explicitly discussed, not by Jakob von Uexküll, who remained fundamentally very much a mechanicist, even if he refused to assimilate animals to machines, but by his disciple Frederik Buytendijk,[11] who described animals as "structuring structures" (1958). This Dutch zoopsychologist considered that animals derive their structure from their autonomy, and he clearly opposed the organism to the subject. While he described plants as organisms, he considered that animals were subjects because they attributed an experienced meaning to their behaviours which were the expression of a purposeful activity. A similar idea can be found, although not explicitly expressed, in the work of the zool-

---

[11] Buytendijk stands at the crossroads of several intellectual traditions. That represented by von Uexküll, of course, but also that of the Amsterdam School of ethology, that of Michotte's experimental psychology and that of Husserl's phenomenology.

ogist Adolf Portmann[12] or the philosopher Hans Jonas.[13] Still, it is from the animal sciences, from ethology and comparative psychology, that the figure of an animal subject can be seen emerging.

One feature of long-term longitudinal studies is that they follow specific individuals in detail and thus draw up genuine biographies. We have not paid enough attention to the growing practice of characterizing an animal through its biography, which supposes a temporal consistency in the idiosyncratic behaviours and "mental states" (preferences, dislikes, skills…) of a given animal. The portrait of the subject which emerges from these field studies is one of a subject with weak autonomy, which has a memory, is capable of foresight, is conscious of its place in the group and has no doubt a minimum degree of self-awareness. While this attitude has become frequent in primatology with regard to animals living in captivity or in the wild, it is also found among bird specialists, for example Zahavi (1990), among elephant specialists, like Poole (1996), and among many others who have studied lions, hyenas, bears, etc. It is no longer a figure of speech to talk about subjects, it has become the expression of a strong hypothesis substantiated by reliable data collected over months and even years, in a systematic and rigorous manner.

A strong heteronomous subject appears in captivity, especially in the context of research on teaching great apes to use symbols. But the strong opposition that still prevails in ethology between animals living "in captivity" and those "in the wild" masks the nature of the new perspectives needed to address the question of an animal "subject".

Can Human Language Change the Nature of Animal Communications? The Human Being as a Universal Interlocutor

Ethologists who talk about "animal culture" and those interested in animal communications adopt a purely "naturalistic" outlook which they fail to justify since, from the outset, they discard the pertinence of animal behaviours which develop in interaction with humans. This kind of attitude is all the more detri-

---

[12] Portmann (1961) has worked extensively on the characteristics of animal forms, and is one of the first zoologists to have taken an interest in the way one animal is seen by another. I suggested that he was opposing, implicitly but productively, an *expressive rationality* to the *instrumental rationality* that zoologists are more inclined to look for in animals (Lestel, 2001a).

[13] Jonas (1982, 1992) developed the idea that the animal's metabolism itself is already a first departure from the necessities dictated by the environment.

mental because the question of the animal subject is closely bound up with the potential relationship between man and animal.

The extent to which an animal's communications are altered by contact with humans is a crucial question rarely discussed so directly; one of the reasons for this is the conviction on the part of most ethologists that the question simply does not arise, except in negative terms. It is widely acknowledged that humans perturb the behaviour of animals, "perturb" being the apposite term, for the phenomenon is always taken in a pejorative sense. The ethologist is said to influence the animal's behaviour and thus to miss its *true* behaviour. Humans' deliberate influence on animals is thus regarded as training or domestication, and falls outside the legitimate field of ethology, which is interested primarily in the "pure" behaviour of animals. Comparative psychologists do not tackle the problem either. They too seek to describe "pure" animal behaviours, except that the notion of purity does not have the same meaning for them. They are not interested in the animal's "natural" behaviour, but in the way it behaves in a space where all stimuli are controlled—and controlled by humans.

Work such as the experiments in teaching anthropoid apes a language using symbols is particularly interesting from the cultural standpoint because these studies are based on a relationship with humans which is no longer *controlled*, as in (behavioural or cognitive) comparative psychology, but which is explicitly *semiotic*, in other words it is a relationship based on the interpretation of signs. I have discussed these elements in enough detail elsewhere (1994, 1995, 1998), not to repeat myself here. Instead, I would like to look at them from the standpoint of animal cultures and the animal subject.

- It is important to reinterpret the experiments on talking monkeys as bearing on communities established between man and animal, and not as psycholinguistic experiments bearing on the animal's ability to acquire human language. While there is no doubt that the chimpanzee has access to *a* symbolic language, he does not talk the way any human can, and it is illusory to hope that an animal will one day be capable of such a performance. What is interesting about this research is that humans and primates live together on a daily basis, in *hybrid communities sharing meaning, interests and affects*, and that these hybrid communities are primarily *semiotic communities.*
- The human being who works on these primates is committed to them. He assumes a major responsibility for them. An important notion for understanding these semiotic communities is that of *cross-fostering families*; these are families in which the primates are raised by members of another species, namely humans. This practice allows the semiotic relationship to develop as the animal grows and, especially, makes it possible to include the duration of the process as an essential dimension.

- In these communities, each animal has a name and a history. It is a subject before being a laboratory animal. Talking apes are strong heteronomous subjects precisely because they have been very successfully integrated into a human culture whose signs they manipulate with considerable ease, and because they are recognized as such by those with whom they interact in these semiotic communities. This strong heteronomous subject communicates its desires, its fears and its joys to the humans. In the course of these talking-ape experiments, a tremendous transference of affects and emotions occurs in which the human explores the animal's "inner spaces"[14]—and vice versa, even if this knowledge is not shared symmetrically. Such subjects are heteronomous because they are organisms about which humans have hopes, fears, joys, sorrows, etc. The empathy between the human and the primate enables a strong semiotic interaction to take place. Throughout the Western philosophical tradition, the question of the subject has been conceived as a corollary of the problem of autonomy. This is a debatable predicate for conceptualizing, in a given cultural space, the animal subject, which is not so much the subject of a defensive autonomy as of an open-ended heteronomy. Being a subject is the consequence not only of possessing cognitive skills but also of occupying a position in the social space. Certain animals can thus become strong subjects through certain associations with human beings. The idea has already been suggested by von Weizaker, who spoke picturesquely of an *angeschaute Subjektivität*, of a "subjectivity seen from outside",[15] but the expression must be rethought on new bases. Such a project requires a keen interest in the behaviours of animals in human communities.
- The idea that an animal can become a subject because it is regarded as such by humans can be clarified by taking a non-classical interpretation of the Turing test and applying it to the idea of a "semiotic community" between man and animal. I believe that the interpretations of the Turing test underrate its fundamental originality. Turing produced three major turn abouts with respect to the classical approaches of the time. He attempted not to define human intelligence but to recognize what was intelligent. He laid down not formal criteria of intelligence, but psychological criteria for recognizing what was intelligent, regarding as intelligent whatever organism was recognized as such by another intelligent organism. Turing thus proposed a co-optative approach to the community of intelligent creatures. Likewise, an animal is

---

[14] This is not to say that the chimpanzee has an inner life to which man might have access, but that the *equivalent* of such an interiority could appear in the course of its interactions with humans.

[15] Quoted by Thinès (1996: 199).

part of the semiotic community if it is capable of entering into communication with those who are already members. Finally, Turing placed deceit and cunning at the heart of intelligent behaviour, since a machine is recognized as being intelligent if it can deceive a human being about its nature.

- One striking point for those who observe talking apes is scarcely discussed, and that is the huge pleasure the apes take in these experiments. One of the outcomes of this work, it seems to me, should be to revisit the role of play and pleasure in the appearance of language in particular and in other biosemiotic systems in general.[16]
- The work on talking apes prompts another question that is rarely raised, namely the capacity of human language to alter an animal's own semiotic system. For at the end of these experiments, if it is clear that the chimpanzee can "talk" using conventional symbols, it is equally clear that it does not do this in the same way as humans do. The great omission in this work on talking apes is precisely the failure to acknowledge the essential role played by humans in the process of language acquisition by chimpanzees, except to make a methodological objection which is hardly convincing (the Clever Hans effect). While chimpanzees are capable of communicating via symbols, it is humans who have imposed the symbols they use. Furthermore, Kanzi's natural calls are different from those of a "normal" bonobo (he vocalizes more[17] and uses new sounds). It is also worth noting that Washoe, who learned ASL (American Sign Language), taught it to Louis.[18] Two animals thus learned to communicate with each other using an artificial system of symbols invented by humans.

Beyond their own specific case, the situation of talking apes shows the importance of including animals which are an integral part of human cultures when dealing with the question of cultural behaviours in animals and the semiotic dimension of such behaviours. Far from augmenting the gap between humans and animals, language on the contrary brings them closer together. Language enables humans to become universal interlocutors, capable of communicating

---

[16] Kummer (1992) writes about the interest of using a satisfaction value for the individual and the inadequacy of considering only a survival value for genes.

[17] This phenomenon provides food for thought: does contact with humans make animals *talkative?*

[18] Washoe has been taught ASL by the Gardners (Gardner et al., 1989) in the 1960s and 1970s. Louis, Washoe's adopted son, has learned ASL through Washoe's teaching (Fouts et al., 1989). Kanzi is a bonobo who has learned a symbolic language especially designed for human/chimpanzee communication (cf. Savage-Rumbaugh et al., 1993).

with all living beings.[19] This proposition is by no means to be taken literally, however: animals and humans cannot talk to each other, except in fables or animated cartoons. But with the help of language humans can develop a sophisticated knowledge of non-human communications and thus gain access to their meaning.[20] One of the reasons for this ability lies in the fact that, basically, we all live in the same world[21] and, from an evolutionist point of view, we were all confronted with constraints, different to be sure, but which were of the same nature, and revolved around subsistence and reproduction. The idea is no doubt hard to accept in the present context, but it is far from being recent, if one is willing to interpret this ability as a symbolic version of the myth of Noah's ark in which specimens of all the world's animals lived together to escape from the flood. Language enables men to become highly efficient at capturing animals, but also at developing a wealth of relations with them on many levels. It is certainly trivial to claim that a science of the animal world would be unthinkable without language, but it is just as trivial to recall that the social sciences have never sought to draw any conclusions from man's capacity to generate a body of knowledge on the behaviour and psychology of animals which would be of help in characterizing human societies.

Animal Cultures within Human Cultures

The talking-ape studies deal with the hybrid communities that can grow up between humans and animals rather than with the classical psycholinguistic question of the extent to which non-human primates can acquire human language, even though the two points are not incompatible. These apes are genuinely integrated in a human culture. More generally, animals which adapt to human cultures and which develop distinctive regional features are largely neglected in the debates on animal cultures. The major texts on animal cultures deal with two specific and mutually exclusive domains: wild animals, on the one hand, and animals tested in experimental psychology laboratories, on the other. Interest in these two areas follows two easily identified, divergent logics, whose stakes are just as easily identified. In the first case, the problem is to reconstitute what could be called a phylogenesis of culture, while in the second the objec-

---

[19] I developed this idea in Lestel, 2001b.

[20] There is a famous discussion by Nagel (1974) on subjectivity in bats. Lestel (1999) criticizes Nagel's argumentation on the limits of our ability to elaborate objective representations of bats' subjective representations.

[21] Even if our senses give us many ways of accessing the world, it is always the same world. "Uexküllians" are rarely clear about this.

tive is to test for the existence of important cognitive mechanisms assumed to underlie cultural behaviour in general, and in particular the ability to learn from another, to transmit information or to imitate a conspecific. Conversely, discussions on animal cultures exclude, without convincing justification, talking apes and more generally all animals already living in human cultures and perfectly adapted to them.

Yet every human society is characterized by the nature of the hybrid communities its members establish with animals, which takes into account the animals involved and the structure of the relationships established. Such hybrid communities are above all, I repeat, semiotic communities, as in the case of the talking apes. It is interesting to see that, whereas Haudricourt and Dibie (1988) argue that domestic animals should be studied from an ethological standpoint like wild animals, and that ethologists should investigate their behaviours with regard to humans, all of the examples they discuss are fundamentally semiotic ones, though they fail to attach the slightest importance to this essential dimension of human/animal relations in shared communities. Yet it is precisely because humans and animals are able to share common codes that they can constitute shared communities. Every human society is *also* an animal society, but the tree of domestication hides the richness of the forest of human/animal relations. Every human society has always developed privileged ties with at least one animal species; Amazonian villages, to take only one example, are veritable menageries whose animal population often exceeds the human one.[22] We thus need to rethink the role and the importance of human/animal relations when attempting to draw up a history of the cultural rationalities developed together by humans and animals in their various associations. Although this domain is still relatively unbroken ground, a few notions have been suggested to account for the complexity of these associations, such as mutual domestication (Lestel, 1998) or cognitive prosthesis. An essential feature of hybrid communities is that they are semiotic communities which share a rationality. What changes does the rationality of one agent undergo when it regularly interacts with another agent possessing skills very different from its own? The same question can be asked when it comes to the organization of intertwined rationalities, for example in the case of guide-dogs or the even more interesting case of autistic humans using a dog to interact with other humans.[23] A genuine inter-rationality—both expressive and instrumental—thus grows up between man and animal, but also

---

[22] P. Descola, pers. com.

[23] Grandin (1995), a professor of ethology at the University of Colorado at Boulder, who is autistic, explains clearly how she interacts much better with animals than with humans.

between animals living in human spaces. Ingold (1994) is one of the few anthropologists to have really addressed this question, when he suggested doing a history of the relations between man and animal, starting not from the classical opposition between wild and domestic animals, but from the distinction between two behavioural paradigms, namely the paradigm of trust and that of control. For Ingold, domestication establishes a relationship which shifts from the first paradigm, typical of hunter-gatherers, to the second, which is more characteristic of domestication. The question is not only what is animal intelligence, but also how do humans and animals allow each other to be *differently* intelligent. The comparative study of human societies would stand to gain by determining the logic of the rationalities each community brings into play in its relations with living beings, something anthropologists have done for the most part, but also practically speaking, on which they have had less to say. We could thus try to develop a true typology of human/animal relations by constructing a theory of proximities. Human/animal relations are rooted in the establishment of numerous proximities, at very different levels,[24] which constantly intertwine in elaborate combinations: between species, first of all, but also between groups and between individuals. This domain of inter-relations is still largely unexplored. Nevertheless two important points are worth keeping in mind.

(1) We classify animals by pre-established categories, which hinders our understanding of the composition of hybrid communities, for example when we oppose wild and domestic animals. In so doing, we oversimplify a space of possibles and we obliterate the great diversity of the situations encountered (taming, habituation, familiarity, commensalism, etc.).

(2) The cognitive dimension of these exchanges between humans and animals should not be underestimated, nor should the multiplicity of the rationalities called upon.

Once again the academic organization of knowledge has difficulty conceiving of the pertinent interfaces. With the exception of a few shining examples, social scientists still take insufficient interest in the cognitive skills of the agents involved in the associations they study. This is true of Tim Ingold as well, even though he considers the anthropological approaches to domestication highly unsatisfactory. Conversely, cognitive scientists base their work massively on categories which are a priori too coarse-grained effectively to account for the complexity of the stakes involved in these interspecific interactions. One issue which ethologists address with extreme caution, namely that of behavioural in-

---

[24] While ethology often thinks in terms of levels, it does not reason in terms of scales, for reasons that I explain in Lestel, 2001a.

novation, is very interesting from this standpoint (Lestel, 1996). It is because both humans and animals are basically incomplete that such strong shared communities can grow up.

The rationalities underlying a decision-making process involving subjects using rationalities which cannot be reduced to one another are thus a rich subject of study and go straight to the heart of the phenomenon of culture, seen not from the standpoint of behavioural differences but from that of ways of manipulating the rationalities involved in an action. The situation is further complicated by the various statuses (affective, instrumental or aesthetic) assumed by these associations. Sigaut (1988) was one of the first to call attention to the growing inadequacy of the traditional notion of domestication to account for the diversity of human/animal relations and to consider that these lay on at least three levels—juridical, ethological and economic. However, we still know too little about the material basis of the rational procedures involved in the acculturation of animals. Humans and animals both are sensitive to rhythms and communicate with each other by this means. It is because our rhythms converge with those of the animal that we can share communicating temporalities, that we can express shared emotions, and that we can co-ordinate our actions with this in view of a goal, shared or not. The issue of the joint occupation of spaces is another remarkable avenue of investigation for concretizing the question of human/animal communications and their underlying associations. Humans are those living beings which invent new and original avenues of access to other living beings using non-living mediators. An active materiality gives rise to "selective associations" which constantly weave links between man and animal and at the same time contribute to increasing the frequency of the signs exchanged and to selecting among them. An *architecture of human/animal relations* deserves exploration; this architecture would involve both hardware and software. After all, what good is a snakecharmer without a basket? Man's co-habitation with animals is organized around a very subtle sharing of space which we have not yet begun to appreciate. Generally speaking, we do not give enough importance to the material basis of the rational strategies we set in place. If ethologists have placed a great deal of emphasis on the organization of animal territories, they have remained relatively insensitive to the way this negotiated space is shared by animals and humans.

Their work is troubling because it introduces a historical dimension into animal behaviours, which are generally regarded as natural, and therefore lacking just such a temporal dimension. But it is precisely because animal societies can be characterized by their historicity and because the organisms which comprise them can be conceived as subjects of a kind that they can be the objects of a genuine ethnology and can be considered to be cultures.

Ethology, the Social Sciences and Biosemiotics

The objective I have tried to defend in this article was not to compare the results of unconnected or even hostile disciplines each having a very different academic tradition, but to elaborate a strategy aimed at addressing jointly the question of animal societies and human societies by adopting an approach in which the two could be thought together. A first step in this direction is to rethink ethology in a non-naturalist perspective and the social sciences in an evolutionist perspective.[25] Every animal and every human can, in this case, be regarded as a potential field of action, and animal behaviours can be conceived in terms of an ecology of rationality within an extended semiosphere. The term "ecology" refers to the social and cultural dimension of the activities underlying these rationalities, but also to the evolutionist perspective from which they stem. The notion is of course borrowed from Bateson (1972), and the Herbert Simon (1954) of "bounded rationality" is another source of inspiration for this approach. But whereas the American economist-philosopher defined this limitation in terms of lack of access to the information needed for decision-making, we consider that the rationality of the actors we are concerned with is further limited by the skills they have acquired or inherited for exploiting this information and, in particular, their semiotic abilities to produce signs and to interpret those produced by others or by the environments[26] in which they find themselves. The social sciences tend to neglect the idea of describing a society—be it human or other—in terms of necessary and sufficient conditions. What actually differentiates every human society from *all* other animal societies, and what is the nature of these differences? One way of tackling the problem is to make a list of all the rational strategies that humans can use and of the semiotic skills they need in order to do this.

Ethology, biosemiotics and the cognitive sciences thus hold out the opportunity to approach the phenomenon of culture in an entirely new way, provided they equip themselves with the will and the means to lay out a general social science aimed at developing an authentic science of society, and not merely of human societies, one which seeks out the differences between the various animal societies as well as those which set these apart from human societies. This position is close to that of Anglo-Saxon cognitive anthropology, which considers that the similarities between human societies go deeper than their divergences,

---

[25] Which is not necessarily sociobiology, as Ingold (1989) shows so well.

[26] Nothing authorizes us to consider that, from this point of view, animals make a subject/object distinction, which is proper not to humans in general, but to those living in Western societies—pending proof to the contrary.

and that they can be explained in terms of cognitive skills, in the full sense of the term. Our position differs, however, in that it considers that the characteristics of human societies can truly be appreciated only in a broader comparative perspective in which each animal species functions in its own rational and semiotic space, to which humans can gain access by studying the specific cognitive abilities of the species in question. From this standpoint, human societies are not *special*, but they are *specific*. More accurately, they are specific from the zoological point of view, but this is far from exhausting the question. From the anthropologist's viewpoint, human societies are instead specific societies which think of themselves as special societies, and this feature is essential in accounting for them. Twenty-five years after the provocative forecast of Wilson (1975), who predicted that the social sciences would be swallowed up by the biological sciences, it is the social sciences which have shown the capacity to account for animal associations, something that was until now regarded as the exclusive purview of biology.

The battle of certain ethologists to convince social scientists that some animals have cultures just like humans is a lost cause. Such a conception is not only culturally unacceptable, it is above all scientifically erroneous. Cultural ethologists have within their reach what may be an even bolder thesis, that of the plurality of cultures, human culture being only one variety among others. In this sense, the social sciences are as much a challenge to ethology as the reverse, and in a way the challenge is the same in both cases. The problem is not to look at humans as though they were animals, or at animals as though they were humans, but to invent models of social behaviour which make it possible to think the two jointly, along with their respective distinctive features—animal societies, all of them, and human societies, as well as the interfaces between human and animal societies, which have been largely forgotten in the debate on cultural behaviours in animals. The approach to social behaviour in terms of plurality of cultures is not predicated on a relativism which stresses differences of viewpoint. On the contrary, this approach emphasizes the reality of the phenomenon described. It supposes that each society can be apprehended in a significant way through a finite set of procedures—*procedures* and not *mechanisms*—in a necessary and sufficient fashion. It is astonishing to see that such an approach is rarely suggested by the ethologists working on these phenomena.[27] And it is just as surprising to realize that the ethologists talking about culture

---

[27] Boesch and Tomasello (1998) are an exception. Although their approach is very interesting, they limit their work to human and chimpanzee societies, and take a very limited view of these differences. Because they do not make a clear distinction between causes and reasons, they fail to discuss what seems to me the central point,

are totally unaware of the stakes at issue in the social sciences and of the fundamental theoretical difficulties raised by their propositions. When Boesch and Tomasello (1998) evoke the question of chimpanzee culture, their discussion revolves exclusively around cognitive issues: are great apes capable of imitating conspecifics or not? Likewise, when De Waal (2001) presents a popularized and very lively version of the question, visibly targeted at a wide readership, he adopts the same attitude as all ethologists to comparing human and animal societies—a certain amused and amiably condescending attitude in the case of De Waal, more ferocious in the case of Lorenz or Wilson. The irony directed at social scientists, who know nothing about ethology, could easily be turned around: how can one imagine that reading the Kroeber of the 1920s would qualify ethologists to talk about the social scientists?

Conclusion

There is no longer any doubt as to the importance of studying animal cultures in view of characterizing the phenomenon of culture in general and for understanding human societies. I have taken a very specific position in this article, considering that the phenomenon of culture could be viewed froma phylogenetic and ecological standpoint in which the semiotic dimension is crucial. I predicated my position on the hypothesis that, once a certain—still hypothetical—level of complexity is reached, a "subject" emerges out of the semiotic activities; the appearance of such a subject marks the passage from more or less complex social associations to genuine cultures by allowing causal regulations of determined behaviours to be replaced by reasons. In this perspective, the issue of the evolution of meaning is crucial for coming to grips with the phylogenesis of culture, as is that of the complexity of the communications of the agents which make up the societies. Yet both of these questions are still for the most part neglected in ethology and practically ignored in the debates on animal cultures. By addressing the situation of hybrid human/animal communities, I wanted to call attention to the important place animals occupy in human societies and to the need to take this massive phenomenon into account when trying to understand them. It is illusory to oppose human and animal societies because every human society is also a society made up of animals. I have suggested elsewhere (Lestel, 2001b) that the distinction enjoyed by human societies of being so polyspecific has to do precisely with language, and more precisely with that feature peculiar to language of being able potentially to understand and decode

---

the extent to which chimpanzees are capable of consciously changing certain features of the societies they live in.

all communications—human or other—and consequently involve animals effectively and deeply in the life of these societies.

Two questions can be posed at this stage. First, would human societies have developed in the same way in a space without animals? And second, what place do human societies assign animals in their organizations? This is one of the major questions glossed over in our approach to human societies. With the rise of biotechnologies and the heated discussions on animal rights, on the legitimacy of industrial farming and on protecting biodiversity, these have become burning questions.

I would like to end on a personal note: one thing has always struck me in the organization of the most remarkable utopias of Western literature, and that is the total absence of animals.

References

Bateson, G.
1972 *Steps to an Ecology of Mind*. New York: Chandler.

Bateson, G.
1977 "Une théorie du jeu et du fantasme". In: G. Bateson *Vers une écologie de l'esprit*. 1, pp. 209–24. Paris: Seuil. (Orig. published 1955.)

Bateson, G.
1980 "Problèmes de communication chez les cétacés et autres mammifères". In: G. Bateson *Vers une écologie de l'esprit*. 2, pp. 118–32. Paris: Seuil. (Orig. published 1966.)

Boesch, C.
1991 "Symbolic Communication in Wild Chimpanzees", *Human Evolution* 6: 81–90.

Boesch, C. and M. Tomasello
1998 "Chimpanzee and Human Cultures", *Current Anthropology* 39(5): 591–614.

Bohannan, P.
1973 "Rethinking Culture: A Project for Current Anthropologists", *Current Anthropology* 14(4): 357–72.

Buytendijk, F.
1958 *Mensch und Tier*. Hamburg: Rowohlt Taschenbuch Verlag.

Byrne, R. W. and A. Whiten
1988 *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes and Humans*. Oxford: Clarendon Press.

Cleveland, J. and C. T. Snowdon
1982 "The Complex Vocal Repertoire of the Adult Cotton-Top Tamarin (Saguinus Oedipus)", *Zeitschrift für Tierpsychologie* 58: 231–70.

De Waal, F.
2001 *The Ape and the Sushi Master*. New York: Basic Books.

Dennett, D.
1987 *The Intentional Stance*. Cambridge, MA: MIT Press.

Deputte, B.
1982 "Duetting in Male and Female Songs in the White-Cheeked Gibbon (Hylobates Concolor Leucogenys)". In: C. T. Snowdon, C. H. Brown and M. R. Petersen (eds.), *Primate Communication*, pp. 67–93. Cambridge: Cambridge University Press.

Donald, M.
1991 *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. Harvard, MA: Harvard University Press.

Espinas, A.
1935 *Des sociétés animales*. Paris: Félix Alcan.

Fisher, J. and R. A. Hinde
1949 "The Opening of Milk Bottles by Birds", *British Birds* XLII: 347–57.

Florkin, M.
1974 "Concepts of Molecular Biosemiotics and of Molecular Evolution", *Comprehensive Biochemistry* 291: 1–124.

Ford, J. K., G. M. Ellis, and K.C. Balcomb
1994 *Killer Whales*. Vancouver: University of British Columbia Press and Seattle: University of Washington Press.

Fouts, R. S., D. H. Fouts, and T. Van Cantford
1989 "The Infant Louis Learns Signs from Cross-Fostered Chimpanzees". In: A. Gardner et al. *Teaching Sign Language to Chimpanzees*. New York: State University of New York Press.

Gardner, A., B. Gardner, and T. Van Cantford
1989 *Teaching Sign Language to Chimpanzees*. New York: State University of New York Press.

Gould, J.
1974 "Honey Bee Communication", *Nature* 252: 300–1.

Gould, J.
1975a "Communication of Distance Information by Honey Bees", *Journal of Comparative Physiology* 104: 161–73.

Gould, J.
1975b "Honey Bee Recruitment: The Dance-Language Controversy", *Science* 189: 685–92.

Gould, J. and Gould, C.
1988 *The Honey Bee*. New York: Freeman Press.

Grandin, T.
1995 *Thinking in Pictures and Other Reports from My Life with Autism*. New York: Doubleday.

Grant, B. R. P. R. and Grant

1996 "Cultural Inheritance of Song and its Role in the Evolution of Darwin's Finches", *Evolution* 50: 2471–5.

Griffin, D.

1981 *The Question of Animal Awareness*. New York: Rockefeller University Press.

Hailman, J. P. and M. S. Ficken

1987 "Combinatorial Animal Communication with Computable Syntax: Chick-a-Dee Calling Qualifies as 'Language' by Structural Linguistics", *Animal Behaviour* 34:1899–901.

Hailman, J. P., M. S. Ficken, and R. W. Ficken

1985 "The 'Chick-a-Dee' Call of Parus Atricapillus: A Recombinant System of Animal Communication Compared with Written English", *Semiotica* 56: 191–224.

Hailman, J. P., Ms S. Ficken, and R. M. Ficken

1987 "Constraints on the Structure of Combinatorial 'Chick-a-Dee' Calls", *Ethology* 75: 62–80.

Haldane, J. B. S.

1953 "Rituel humain et communication animale", *Diogene* 4: 77–93.

Hartshorne, C.

1973 *Born To Sing*. New York: Harper and Row.

Haudricourt, A. G. and Dibie, P.

1988 "Que savons-nous des Hausberger, M., M. A. Hausberger, L. Richard-Yris, L. Henry, L. Lepage, and I. Schmidt

1995 "Song Sharing Reflects the Social Organization in a Captive Group of European Starlings (*Sturnus vulgaris*)", *Journal of Comparative Psychology* 109(3): 222–41.

Hauser, M.

1988 "How Infant Vervet Monkeys Learn to Recognize Starling Alarm Calls", *Behaviour* 105: 187–201.

Hauser, M.

1996 *Evolution of Communication*. Cambridge, MA: MIT Press.

Hauser, M. and C. Fowler

1991 "Declination in Fundamental Frequency is not Unique to Human Speech: Evidence from Nonhuman Primates", *Journal of the Acoustical Society of America* 91: 363–9.

Hinde, R. A. and J. Fisher

1951 "Further Observations on the Opening of Milk Bottles by Birds", *British Birds* XLIV: 393–6.

Holloway, R.

1969 "Culture: A Human Domain", *Current Anthropology* 10(4): 395–412.

Hunt, G.
1996 "Manufacture and Use of Hook-Tools by New Caledonian Crows", *Nature* 379: 249–51.

Imanishi, K.
1952 *Evolution of Humanity*. Tokyo: Mainichi-Shinbunsha.

Ingold, T.
1989 "An Anthropologist Looks at Biology", *Man (N.S.)* 25: 208–29.

Ingold, T.
1994 "From Trust to Domination: An Alternative History of Human-Animal Relations". In: A. Manning and J. Serpell (eds.), *Animals and Human Society: Changing Perspectives*, pp. 1–22. London: Routledge.

Jonas, H.
1982 *The Phenomenon of Life: Toward a Philosophical Biology*. Chicago, IL: University of Chicago Press.

Jonas, H.
1992 *Philosophische Untersuchungen und metaphysische Vermutungen*. Berlin: Insel Verlag.

Kawai, M.
1965 "Newly Acquired Pre-Cultural Behavior of a Natural Troop of Japanese Monkeys on Koshima Island", *Primates* 6: 1–30.

Kawamura, S.
1959 "The Process of Sub-Culture Propagation among Japanese Macaques", *Primates* 2: 43–60.

Kitahara-Frisch, J.
1991 "Culture and Primatology: East and West". In: L. Fedigan and P. Asquith (eds.), *The Monkeys of Arachiyama*, pp. 74–80. Albany, NY: SUNY Press.

Kull, K.
1999a "On the History of Joining *Bio* with *Semio*: F. S. Rothschild and the Biosemiotic Rules", *Sign Systems Studies* 27: 128–38.

Kull, K.
1999b "Biosemiotics in the Twentieth Century: A View from Biology", *Semiotica* 127(1/4): 385–414.

Kull, K.
1999c "Towards Biosemiotics with Yuri Lotman", *Semiotica* 127(1/4): 115–31.

Kummer, H.
1971 *Primate Societies*. Chicago, IL: Aldine-Atherton.

Kummer, H.
1992 *Weisse Affen am Roten Meer*. Munich: R. Piper.

Lestel, D.
1994 "Symbols of Discord: Are Apes that Talk Trivia More Interesting than Apes that Do Not Talk?", *Social Science Information* 33(2): 335–69.

Lestel, D.
1995 *Paroles de singe: l'impossible dialogue homme/primate*. Paris: La Découverte.

Lestel, D.
1996 *L'animalité: essai sur le statut de l'humain*. Paris: Hatier.

Lestel, D.
1998 "How Chimpanzees have Domesticated Humans: Towards an Anthropology of Human/Animal Communication", *Anthropology Today* 14(3): 12–15.

Lestel, D.
1999 "Portrait de l'animal comme sujet", *Revue de Synthèse* 1: 139–64.

Lestel, D.
2001a *Les origines animales de la culture*. Paris: Flammarion.

Lestel, D.
2001b "Human/Animal Commmunications, Language and Evolution", paper presented at "Gathering in Biosemiotics I", Copenhagen, May.

McCowan, B. and D. Reiss
1995 "Quantitative Comparison of Whistle Repertoires from Captive Adult Bottlenose Dolphins (Delphinidae, Tursiops truncatus): A Reevaluation of the Signature Whistle Hypothesis", *Ethology* 100: 193–209.

McGrew, W.
1992 *Chimpanzee Material Culture*. Cambridge: Cambridge University Press.

McGrew, W. and C. Tutin
1978 "Evidence for a Social Custom in Wild Chimpanzees?", *Man* 13: 234–51.

Marler, P.
1977 "The Evolution of Communication", in T. Sebeok (ed.), *How Animals Communicate?*, pp. 45–70. Bloomington: Indiana University Press.

Mithen, S.
1996 *The Prehistory of Mind: The Cognitive Origins of Art and Science*. London: Thames and Hudson.

Moller, A.P.
1988 "False Alarm calls as a Means of Resource Usurpation in the Great Tit, Parus Major", *Ethology* 79: 25–30.

Muller, U., S. Rehner, and T. Schultz
1998 "The Evolution of Agriculture in Ants", *Science* 281: 2034–8.

Mundiger, P. C.
1970 "Vocal Imitation and Individual Recognition of Finch Calls", *Science* 168: 480–2.

Munn, C. A.
1986 "Birds That 'Cry Wolf' ", *Nature* 319: 143–5.

Nagel, T.

1974 "What is it Like to Be a Bat?", *Philosophical Review* 83: 435–50.

Newman, J. D. and D. Symmes

1982 "Inheritance and Experience in the Acquisition of Primate Acoustic Behavior". In: C. T. Snowdon, C. H. Brown and M. R. Petersen (eds.), *Primate Communication*, pp. 259–78. Cambridge: Cambridge University Press.

Nishida, T.

1973 "The Ant-Gathering Behaviour by the Use of Tools Among Wild Chimpanzees of the Mahali Mountains", *Journal of Human Evolution* 2: 357–70.

Nishida, T.

1980 "The Leaf-Clipping Display: A Newly Discovered Expressive Gesture in Wild Chimpanzees", *Journal of Human Evolution* 9: 117–28.

Nowicki, S.

1989 "Vocal Plasticity in Captive Black-Capped Chickadees: The Acoustic Basis of Call Convergence", *Animal Behaviour* 37: 64–73.

Pola, Y. and C. T. Snowdon

1975 "The Vocalizations of Pygmy Marmosets (Cebuella pygmaea)", *Animal Behaviour* 23: 826–42.

Poole, J.

1996 *Coming of Age with Elephants: A Memoir*. New York: Hyperion.

Portmann, A.

1961 *La forme animale*. Paris: Payot.

Radcliffe-Brown, A.

1952 *Structure and Function in Primitive Society*. London: Cohen and West.

Robinson, J. G.

1984 "Syntactic Structures in the Vocalizations of Wedge-Capped Capuchin Monkeys", *Behaviour* 90: 46–79.

Savage-Rumbaugh, E. S., J. Murphy, R. A. Sevcik, K. E. Brakke, S. L. Williams and D. M. Rumbaugh

1993 "Language Comprehension in Ape and Child", *Monographs of the Society for Research in Child Development*, 58(3–4).

Savage-Rumbaugh, E. S., S. L. Williams, T. Furuichi, and T. Kano

1996 "Language Perceived: Paniscus Branches Out". In: W. McGrew, L. Marchant and T. Nishida, *Great Ape Societies*, pp. 173–84. Cambridge: Cambridge University Press.

Schricker, B.

1974 "Der Einfluss subletaler Dosen von Parathion (E605) aus die Entferningsweisung bei der Honigbiene", *Apidologie* 5: 149–75.

Sebeok, T.
1962 “Coding in the Evolution of Signalling Behavior”, *Behavioral Sciences* 7: 430–42.

Sebeok, T.
1963 “Communication in Animals and Men”, *Language* 39: 448–66.

Sebeok, T. and J. Umiker-Sebeok (eds.)
1992 *Biosemiotics: The Semiotic Web 1991*. Berlin: Mouton de Gruyter.

Seyfarth, R. and D. Cheney
1980 “The Ontogeny of Vervet Monkey Alarm-Calling Behavior: A Preliminary Report”, *Zeitschrift für Tierpsychologie* 54: 37–56.

Seyfarth, R. and D. Cheney
1997 “Some General Features of Vocal Development in Non-Human Primates”. In: C. T. Snowdon and M. Hausberger (eds.), *Social Influences on Vocal Development*, pp. 249–73. Cambridge: Cambridge University Press.

Sigaut, F.
1988 “Critique de la notion de domestication”, *L’Homme* 108, XXVIII, 4:59–71.

Simon, H.
1954 “A Behavioral Theory of Rational Choice”, *Quarterly Journal of Economics* 69: 99–118.

Smolker, R. A., A. F. Richards, R. C. Connor, J. Mann, and P. Berggren
1997 “Sponge-Carrying by Indian Ocean Bottlenose Dolphins: Possible Tool-Use by a Delphinid”, *Ethology* 103: 454–65.

Snowdon, C. T.
1999 “An Empiricist View of Language Evolution and Development”. In: B. King (ed.), *The Origins of Language: What Nonhuman Primates Can Tell Us*, pp. 79–114. Santa Fe, NM: School of American Research Press.

Struhsaker, T. T. and P. Hunkeler
1971 “Evidence of Tool-Using by Chimpanzees in the Ivory Coast”, *Folia Primatologica* 15: 212–19.

Strum, S.
1987 *Almost Human: A Journey into the World of Baboons*. New York: Random House.

Tembrock, G.
1971 *Biokommunikation: Informationsübertragung im biologischen Bereich*. Berlin: Berlin Akademie-Verlag.

Thielke, G. and H. Thielke
1964 “Beobachtungen an Amseln (*Turdus merula*) und Singdrossen (*Turdus philomelos*)”, *Die Vogelwelt* 85: 46–53.

Thinès, G.
1996 "La forme animale selon Buytendijk et Portmann", *Etudes phénoménologiques* 23-4: 195–207.

Van Lawick-Goodall, J.
1968 "The Behaviour of Free-Living Chimpanzees in the Gombe Stream Reserve", *Animal Behaviour Monographs* 1(3): 161–311.

Van Lawick-Goodall, J.
1973 "Cultural Elements in a Chimpanzee Community". In: E. Menzel Jr. (ed.), *Precultural Primate Behavior*, pp. 144–84. Basel: S. Kerger.

Von Uexküll, J.
1982 "The Theory of Meaning", *Semiotica* 42(1): 1–87.

Washburn, S. and B. Benedict
1979 "Non-Human Primate Culture", *Man* 14: 163–4.

Whiten, A., J. Van Lawick-Goodall, W. McGrew, V. Reynolds, Y. Sugiyama, C. Tutin, R. Wrangham, and C. Boesch
1999 "Cultures in Chimpanzees", *Nature* 399: 682–5.

Wilson, E. O.
1975 *Sociobiology: The New Synthesis*. Harvard, MA: The Belknap Press of Harvard University Press.

Wilson, E. O.
1998 *Consilience*. Harvard, MA: Harvard University Press.

Zahavi, A.
1990 "Arabian Babblers: The Quest for Social Status in a Cooperative Breeder". In: P. Stacey and W. Koenig (eds.), *Cooperative Breeding in Birds*, pp. 105–32. Cambridge: Cambridge University Press.

Biotranslation: Translation between Umwelten*

Kalevi Kull and Peeter Torop

> Dank der Übernahme fremder Motive gestaltet sich der Körper
> eines jeden Subjektes zu einem Bedeutungsempfänger jener Bedeutungsträger,
> deren Bildungsmelodien als Motive in seinem Körper Gestalt gewonnen haben.
> (J. v. Uexküll 1940: 54)

Conversation with nature has a direct, non-metaphoric meaning, if (a) there exist signs besides the human signs, (b) it is possible to understand these signs, and (c) it is possible to restore these signs. The biosemiotic view that there exist signs, *per se*, in animal communication, or in any other communication among living systems, poses the question about the translatability of these signs, both by humans and by other organisms.

Since *talking with nature* has been so often used in an anti-scientific way, a serious attempt to approach this topic may cause a feeling of fear, as expressed by Umberto Eco (1988: 15). However, we may consider a trivial situation with a man and his cat, and ask whether the man can understand what his cat is staring at when it miaows at the door. If he can (and this is possible), then is this the same as what the cat itself means? Probably not exactly the same. And when the cat sees the man approaching the door, it is seemingly expecting him to open it. This might be quite the same as what the man has in mind, but certainly not his whole thought. Thus, it seems to be quite natural to believe that living organisms of different species are able to mutually access some signs, without using a word. Accordingly, we may ask directly, whether an animal message can be translated into a human one?[1]. Can a human message be translated into an animal one? And can animals themselves do any translation?

---

* From: Kull, Kalevi; Torop, Peeter 2003. Biotranslation: Translation between umwelten. In: Susan Petrilli (ed.). *Translation Translation*. Amsterdam: Rodopi, 313–328. Reproduced with permission of Rodopi.

[1] As stated by Louis Hjelmslev (1973: 115): "Language […] is a sign system into which all the other sign systems can be translated".

As we have seen from the example above, a cat might be able to construct a denotatum which overlaps to a certain extent with the one of the man, whereas a door (or any other non-living object) evidently cannot do so.

The notions *dead, living*, and *self-conscious* (as well as *signifying*)—clearly very obvious and natural characteristics—are not liked by natural scientists when defining terms or building models. Biology, chemistry, and physics, when developing their theories, have been trying more and more to escape these notions, at the same time being led by a wish to explain them. Accordingly, in the history of natural science one can follow a clear trend towards replacing these terms with thermodynamic, molecular, and cybernetic ones, leaving *death, life, consciousness* and *signification* more and more with only a metaphoric status. The ring dance with these notions has taken these features from inside to outside of the circle of operational scientific terms.

Indeed, it has been very difficult to define these terms via their mechanisms. On the other hand, these are simple categories. It is not easy to be mistaken when applying them, particularly considering that these are all living, self-conscious and signifying scientists who are using them in creating scientific texts. Thus, if the semiotic paradigm change will take place in biology, these simple categories may be moved back into use as operational terms. Furthermore, much of the terminology of semiotic discourse can be used in life science.

One of the reasons for developing biosemiotics is an attempt to find simpler explanations for complex phenomena with the help and application of a semiotic approach and its concepts. To discover an entrance to the organic sign systems, assumes that we understand how signs are created and translated in nature itself.

Translating, as people do from one language into another, is usually a self-conscious process. Accordingly, most of literary translation theory stands within this framework. If applying the notion to unconscious processes, i.e., considering that there exists an unconscious translation, it becomes reasonable to distinguish between two main types of translation: *protranslation* and *eutranslation*, or we may call them also *biotranslation* and *logotranslation.* There is no translating in the non-living. Eutranslating is conscious translating, as opposed to unconscious translating, the latter still being always a process of the living. Every conscious translation assumes an unconscious component, i.e. every eutranslation assumes biotranslation.

On one hand, eutranslation is a directed activity, which frames the interpretation level and determines the dominant (which may be the original, the translation, or the readers). On this basis, the translation method is formed as a set of technical procedures. On the other hand, reading and translating the text originates from the feeling of comfort, i.e., one recognises rhythm, proportions, etc. The convenience of reading depends on the activation of senses—the more visual, the more correspondent, both spatially and temporally, is the translation, and the easier it is to read it (cf. Schulte 1980; Caws 1986). For instance, a noticeable oversight of novice translators concerns the usage of tenses, which may destroy the continuity of text. However, among translators there are some who use intuition, who perceive the specifics of the original via the rhythm and intonation without recognising the technical problems (Wilss 1988). Some texts may open sufficiently on such a basis. For linguistic texts, it may even be stated that in the community of discrete and continuous aspects, the latter is more important. Mistakes in words can be replaced, whereas mistakes in perception may require a new translation. "A theory of how sign tokens are exchanged and connected must be supplemented with a notion of how signs together form an interrelated system" (Mertz 1985: 16).

Quite generally, if we take a *living* system which exists within a larger living system, and transfer it into another large living system where it will stay living, then this whole process seems to be very much homologous with translation. Similarly, the transmission of texts from one environment to another reflects the ecology of translation.

Since the difference between eu- and biotranslation comes largely from the difference in the *translator* (i.e., whether the translator is a conscious or unconscious organism), and since a large part of translation theory is quite independent from the notion of *translator*, we do not see any real restriction which may not permit the application of translation concepts to the situations and phenomena of biotranslation.

The quest for translation theory in biology is also connected with the search for an adequate methodology for biology. Since the modern age, nature mastered by technology has become the instrument of science. For living systems, it is very much a destructive technology. An approach to biology that makes organisms understandable via translation technology which is able to transmit (and make understandable) the life of a sign system, the meaning of a biotext, both in its details and in its wholeness, without destroying it, would be an aim for any biologist. The individuality (in the sense of uniqueness) of the original, which a translator can transmit, has always created problems for natural sciences. Thus, *translation can be seen as a method for use in biology.*

Thus, our intention is to analyse the biological examples from the viewpoint of the applicability of the concept of translation. To do this, we need to specify that which we call translation, in terms which might have biological counterparts.

The Concept of Translation, for Biology

Translation, quite generally, means that some signs in one *language* are put into a correspondence with some signs in another language (cf. Barnstone 1994). An additional requirement, but quite hidden and more difficult to define, is that which states that the worlds of the two users of these languages, between whom the translation occurs, should be functionally similar—otherwise the meanings cannot be transmitted. If this is the same person who uses both languages (i.e., when the translator is translating for him/herself), then the situation is trivial. But if these are persons belonging to different cultures and living in very different environments, then this assumption becomes conspicuous.

We assume, following Jakob v. Uexküll (1982), Thomas Sebeok (1989), Jesper Hoffmeyer (1996) and others, that umwelten of organisms are composed of signs. Umwelt can be seen as the sphere of the organism's personal language, its own, quite closed, language sphere. Or, more generally, if considering also simple umwelten—umwelt is the world as it exists in an organism's sign system, i.e., it is the semiotic world of an organism. Or, more specifically, if distinguishing between *langue* and *parole*, then the former is *plan* and the latter is umwelt. It should be admitted that the understanding of umwelt as the acting of the individual sign system does not contradict the understanding of umwelt as a *model* of the world (Sebeok 2001), since any natural and working sign system can be seen as a certain model of the world.

Accordingly, we can generalise our definition and say that translation also means that some signs in one umwelt are put into a correspondence with some signs in another umwelt. In addition, these umwelten have to possess some similar functional cycles.

Let there be two organisms (with their umwelten), A and B. Let A include a sign a, and B include a sign b. Let both these signs have certain behaviourally recognisable representations. That means, A, when recognising a, represents a behaviour a', and B, when recognising b, represents a behaviour b'.

For it to be possible for translation to occur, there must be a certain connection, or overlapping, between the umwelten. This is usually called a message, or text, that is transmitted and should be made understandable. In our case, for instance, let a' be the message to be recognisable in the umwelt of B.

If B will categorise b and a' into one, i.e. into the same category, then we can say that a is *translated* into b. In addition, it is required that A and B include a similar functional cycle, into which a and b belong.

For us as observers, this situation can be observable if a and b have sign vehicles (certain objects) which are distinguishable for us as a_v and b_v. Then, operationally, we can observe this as both a_v and b_v resulting in the behaviour b'.

We may consider the following example with a cat, and two birds of different species—*Parus cristatus* and *Parus montanus.* Belonging to different species, they have their own species-specific umwelt and sign systems. Either one of these birds, if it sees the cat coming too near, flies away. We consider now the situation where these two birds are feeding quite close to each other near the corner of a house. When the cat arrives, *P. cristatus* can see it, whereas *P. montanus* is around the corner and cannot see the cat. *P. cristatus* gives an alarm call and flies away, and, hearing the call, *P. montanus* also flies away.

Considering the definition given above, we may say that *P. montanus* has made a translation, something like translating the alarm call of *P. cristatus* into a possible danger for itself.

If such a translation is symmetrical, i.e. possible in both directions, then it can be called an *interindividual sign system.* In our example, considering that the alarm calls are mutually recognised by both *P. cristatus* and *P. montanus*, this is also an *interspecific* sign system.

For a sign system to be a *language*, we assume an additional feature—syntax, defined as the existence of a special type of signs (defined as syntactic signs) which do not refer to anything else except to a certain type of relationship between signs. Considering (together with Bickerton 1990; cf. also Jablonka, Rechav 1996) that animal communication systems generally do not have syntax, we should say that animal sign systems, except the human ones, are not languages. However, we still think that translation can also be possible for syntax-free sign systems.

It should be admitted that there exists a broader understanding of syntax, which interprets any relationship between categories of the same sign system as syntax, even if there is no differentiation into functional types (like verb and noun) between these categories. Indeed, the categorisation process always presumes a relationship between categories—two things cannot be distinguished without any relationship of one to the other. This broad meaning of syntax can be called *prosyntax* and should be distinguished from *syntax* as it is usually understood when speaking about human languages, and also used by Derek Bickerton (1990) and, here, by us.

In the case of translations between languages, the condition that these are used by humans is so evident that the similarity of the general functional structure of human bodies, as a necessary condition for translatability, can easily remain unnoticed[2]. In the case of translation between different species, though, this requirement becomes important. Particularly, it appears as a significant

---

[2] In the case of handicaps, still, the same problem arises. Similar problems have also been discussed in some contemporary feminist studies.

problem if we ask whether the translation is adequate or not[3] which may be a difficult problem for syntax-free (i.e., prosyntactic) sign systems. A possible criterion for the existence of translation is the survival (staying alive) of the transmitted signs and the feedback of their recognition.

Willard v. O. Quine (1959) points out that it is possible to translate into and from a *jungle language*, and that, in this case, a translation can be successful not on the level of single signs, but on the level of a whole text. Or, as Noam Chomsky (1975) has stated, semantic may precede syntactic, and translatability can be achieved due to the existence of deep structures (cf. Torop 1995).

Translation is a transmission of meaning from one sign system to another. Consequently, the application of the term translation requires the existence of two distinguishable sign systems. In the case of languages, this is usually possible and does not create big problems. Simple sign systems, which consist of only a few signs, and particularly if some of the signs are shared with another sign system, may often be much more difficult to distinguish. For instance, if the alarm call of other species is indistinguishable from the alarm call of one's own species, then these can be seen to belong to the same sign system and, accordingly, there is no translation needed to transmit the meaning. However, if the alarm call performed by an organism is distinguishable, for that organism, from the alarm call of another organism, then there exist different umwelten and, accordingly, a translation between them. If even this is indistinguishable, then we have one and the same umwelt, which may physically behave, of course, as a swarm.

Defining translation as transmission between umwelten generalises the notion of translation as transmission between languages. This, we hope, does not only make it possible to apply some results of translation theory to biology, but, in turn, also emphasises some fundamental aspects in cultural translation theory which have not been given enough attention, e.g., translation as directed to (and by) an individual person.

The Concept of Sign, for Biology

Since our formulation of biological translation uses the term *sign*, we need to specify this notion in relation to our context.

Despite the application of the sign concept, in biosemiotic works of the recent decade, to many biological examples, including some intracellular pro-

---

[3] This is important, since wrong translation may be indistinguishable from non-translation, particularly in the case of the non-human situations which we want to analyse.

cesses, the assumptions required for something to be a sign in biological situations have not been defined clearly enough. Thus, before going further with analysis of translation in the biological realm, we need to specify the notion of sign, attempting to make it a bit more operational for biology.

When does a factor *X* appear as a sign for an organism? This question is crucial, since there are evidently many factors which influence the organism without being signs. For instance, a decrease of temperature from 20 degrees to 17 degrees C has a measurable influence on the rate of many processes in *Paramecium*, without this seemingly being recognised by the organism as a sign. On the other hand, the same *Paramecium* can recognise the bacteria which it can eat, as distinct from anything else it touches (the example described by Uexküll 1992: 342–343).

A factor, X, is a sign for the organism, A, if it results in behaviour via a historically developed code, and this behaviour is recognised (*via another code*) *by the organism, A, as belonging to the same category as the influence of the factor, X.*

Referring to J. v. Uexküll's terms, sign is a unity of *Merkmal* and *Wirkmal.* That means, something is a sign for an organism only if 'how it is perceived' and 'how it is reacted to' are categorised into the same category by the organism (cf. T. v. Uexküll 1987: 169).

Categorisation (both perceptual and motor) is based on an analogue code, whereas recognition is seen as digital. Here, we can therefore directly apply the concept of code duality (Hoffmeyer, Emmeche 1991) as a condition for something to be a sign.

Thus, expressing J. v. Uexküll's approach in the more classical semiotic terms of sign, denotatum and interpretant, we may notice the correspondence between them: sign is *Merkzeichen*, denotatum is *Wirkzeichen*, and interpretant is *Funktionskreis.* This also corresponds well to Roland Posner's formulation of these terms in his writing about Charles W. Morris and George H. Mead (Posner 1987: 28): "The role of a *sign* is played primarily by a stimulus which occurs in the orientation phase of an action […]. The *denotatum* of a sign is primarily an impulse-satisfying object which, as such, occurs in the consummation phase of the action. […] An *interpretant* is primarily the disposition of the actor to eliminate the impulse to act through consummation of the denotatum". Or, as Thure v. Uexküll (1987: 169) has put it, "in the simple formula of *sign = meaning-carrier + meaning* and *meaning = reference to the meaning-utilizer*, 'meaning' has the central function of bracketing heterogeneous elements into a whole (the sign). […] Thus meaning turns out to be a 'drama', which deals with meaning-utilization. […] In this way, signs suddenly come alive".

A particular example of sign transmission is *imitation.* Cecilia M. Heyes (1993: 1000) defines imitation as a phenomenon where “individuals acquire, as a result of observing a conspecific’s behaviour, *X*, the capacity to execute a behaviour that is topographically similar to X”. Adam Miklosi (1999: 349) points out that “for ‘true’ imitation to occur the observer needs both to recognize the goal of the demonstrator and to realize that reaching this goal is only possible by copying the act(s) of the other animal. Copying which does not involve recognition of goal has been termed ‘mimicking’ or ‘response facilitation’ ”. Thus, there is a clear difference between copying and translating signs (cf. Kull 1999b).

Inheritance as Translation

We shall move now, after these necessary preliminary considerations, to some biological examples as candidates for biotranslation.

An interesting example of eutranslation is the educating and nurturing of a child by its parents, in which the personalities of the mother and the father are translated into the personality of the child. Simultaneously, at least genetic, epigenetic, behavioural, and linguistic components can be distinguished as participating in this process. These are also the different types of inheritance, or different inheritance systems (Jablonka et al. 1998).

Given that inheritance systems work in the framework of the general conditions necessary for the process of translation, we have a situation which may allow us to apply the principles of translation theory to biological inheritance systems. In other words, what we shall do in the following is to provide a sketch of a semiotic analysis of inheritance, using the concepts of an extended translation theory.

First, we need to specify the range of applicability of the term *inheritance.* With this we mean that there exists a sequence of patterns which are produced, one on the basis of the other, and that this production requires codes. In addition to this, we assume that each of these patterns can participate, at least potentially, in a process of communication other than translation. We also assume that the production of these patterns is carried out by a living system.

The phenomenon of parents and offspring being alike can be explained by the fact that (1) DNA in parents is copied and transmitted to offspring, and (2) the organism is built up in most of its details using the patterns of DNA. This is the core of the genetic paradigm, as used by neo-Darwinian biology.

DNA-copying being the case, either fully, as in the case of vegetative reproduction, or hybridically, as for sexual reproduction, this still does not mean that the same DNA shared by parent and offspring on a structural level is also the same on a functional level.

What works for the production of a new organism is not the structural genome, but the functional one. The functional genome is the part of the DNA which is read by an organism, i.e., which is used by it in one way or another to build up enzymes and RNAs.

Eva Jablonka et al. (1998) distinguish between four *inheritance systems*: epigenetic (EIS), genetic (GIS), behavioral (BIS), and linguistic (LIS). The means of information transmission include, correspondingly, regeneration of cell structures and metabolic circuits (EIS), DNA replication (GIS), and social learning (BIS, LIS), the latter based on symbols. These inheritance systems transmit variations from generation to generation, the variations including cellular morphology (EIS), DNA base sequences (GIS), patterns of behaviour (BIS), and language structures (LIS). For instance, on the chromatine there are some molecular (methylene) marks, which have a certain relationship to gene expression, and these marks can be, as Eva Jablonka and others have shown, transferred to the daughter cells. This is an example of epigenetic inheritance, which can transfer a message from one generation to another (along the mother line, by the way), without any change in DNA. These marks, indeed, are reversible; however, they can stand where they are for quite a number of generations.

In addition to this, it is important to acknowledge the role of *environment.* For instance, a behaviour pattern in organisms can vary according to the environment in which these organisms live, which means that particular behavioural forms are connected (or limited) to a particular environment. Thus, for instance, what can be inherited via BIS may only be the behaviour used in limited conditions, in the case that this environment remains within its limits. Therefore, the stability of environmental conditions is a necessary part of the inheritance systems, being itself a carrier of a part of the information from generation to generation.

As opposed to a genocentric view of biological evolution, the distinction between several independent inheritance systems makes it clear that GIS cannot explain all that goes on in evolution. Also, we should consider that the change or stability of the environment (i.e., environmental information) is itself an obligatory component of inheritance. Changes in any of these inheritance systems may have evolutionary importance (cf. Kull 1998b, 1999a).

Now, to view inheritance systems as those which effect translations from the umwelt of parent to the umwelt of child, we need to find out whether there is anything like DNA in the organism's umwelt. Since this is seemingly not so on the level of behavioural functional cycles in multicellular animals, we need to move to the intracellular level—to the sphere of microsemiosis, as Thure v. Uexküll et al. (1993) have termed it[4].

On the level of the cell, indeed, DNA is a constituent of functional cycles. A zygote growing into an adult organism is interpreting its DNA, very much like a reader (or translator) interpreting a text which is not created by her/himself, but whose author may already be dead. As regards this example, Hoffmeyer (1996: 19–20) has established a correspondence between DNA and sign vehicle, ontogenetic trajectory and object, fertilised egg and interpretant. "The fertilised egg understands the DNA message. That is to say, it interprets it as an instruction to construct the organism and thus implement the ontogenetic trajectory" (Hoffmeyer 1996: 20). However, this example seemingly requires more elaboration.

Namely, the functional cycle under consideration here is that of gene expression. This is a complex system, which can recognise some patterns in DNA, build up polypeptide and other products as a result of this recognition, and, as a result of such behaviour, either continue reading the DNA or turn its attention away from it.

The main problem, here, with the application of the concept of translation would seem to concern the existence of categorisation. On one hand, there exists the genetic code, which is a result of historical processes and not deducible from physico-chemical laws. On the other hand, it is not yet clear to what extent the gene expression system may be just a result of purely accidental matching (cf. Kauffman 1993).

In the case of perceptual categorisation, the discrete categories are formed due to amplification of meaningful, and non-amplification of meaningless, as discovered in the communication process. Could there be something analogous to this in the case for 'genes as units'? While leaving the final answer open, we may note that different patterns of DNA, as well as different sites of the genome, can be selectively used or suppressed by the gene expression system of the cell, and there exists a possibility to see it as analogous to categorisation.

If gene expression is not just determined by the genes themselves, but is an interpretation process carried out by a cell, with a possibility to do this in several different ways, then we may have a chance to see, in this, a kind of semiotic process. And if, in addition to this, the way of interpretation of its genome by one cell can be transmitted into the way of interpretation in some other cell, we have reason to speak here about this process as a kind of translation.

---

4. On a semiotic analysis of intra-organism processes, cf. also Hoffmeyer 1997, Kull 1998a, Vehkavaara 1998.

Interpretation of the genome by a parent organism can be transmitted to interpretation of the genome by its child. Biologically, this happens due to the work of both genetic and epigenetic inheritance systems jointly. This can be called translation, as far as it seems to correspond to the definition of translation given above.

It is important to notice that the transmission of the genome alone is usually not sufficient to be interpreted adequately by the recipient cell; in addition, much of the epigenetic information is required. Therefore, we think that these systems (EIS and GIS) have to be taken together, as forming the same inheritance system. However, if the epigenetic systems happen to be quite similar in themselves, then it is sometimes possible that in the experiments where the genome of the cell is replaced, the cell may still be able to interpret much of it. This can be seen as analogous to the situation where a text from another culture, about which we have not the slightest knowledge, still may happen to be partly readable for us, due to some general similarities between that culture and our own (cf. Stanosz 1990).

Behavioural patterns, as well as linguistic patterns, can also be transmitted via behavioural (BIS) and linguistic (LIS) inheritance systems. Accordingly, behavioural and linguistic signs can be translated. BIS and LIS are, correspondingly, the different forms of translation.

In molecular biology of recent decades, the term *translation* is among the most commonly used. It is defined as “the step in protein synthesis at which the genetic information encoded in mRNA is used to synthesize a polypeptide chain” (Kendrew and Lawrence 1994: 1094). As generally assumed and often noted, the word *translation* is used in molecular biology as a metaphor (e.g., Emmeche 1994). Indeed, as applied to one particular step in protein synthesis, it is and should stay as a metaphor. However, this same process certainly is a constituent part of a biotranslation process, in which a daughter cell interprets the genome inherited from its mother cell, but the whole process is much richer than the one named as *translation* in molecular biology.

Lessons from the Semiotics of Translation: Further Problems

In the case of translations between human languages, it is generally assumed that the translator knows both languages—from which and into which s/he is translating. In any biological example, we can hardly find this. Accordingly, this is an assumption which we do not use when speaking about biotranslation.

However, this difference between eu- and biotranslation may not be as strict as it appears at first glance. First, translation is certainly possible even with a very poor knowledge of the original language. Second, the boundary between translation and non-translation may be very difficult to draw (cf. Torop 1998). And third, as in the example above with the two species of *Parus*, understanding the other species' alarm call (the alarm calls of these species differ) can be interpreted as partial knowledge of the other species' sign system.

The second questionable point is that the language of the original and the language of the translation have to be different—without that border there would be no translation, but only a repeated reading, just the repetition. The counterargument, here, will be that the umwelten (including the umwelten of the individuals of the same species) *are* different. Otherwise, if the umwelten were identical, then (as Juri Lotman 1978 has emphasised) there would be nothing to communicate about. Consequently, every communication perceived as making a message originating from another umwelt understandable in one's own umwelt, assumes translation (cf. Holz-Mänttäri 1988).

The next question concerns the possibility of translating without any syntax in the message whatsoever. While agreeing that the profound difference in richness between communication systems in humans and in other animals owes very much to the lack of syntax in the latter, this may not mean the inability to translate. Syntax organises complex messages and is very helpful for translation indeed. However, the correct identification of meaning may also be based on the recognition of context, or deep structure, since, as observed by R. de Beaugrande (1980), equivalence in translating must be obtained not between words or grammatical constructions, but, rather, between the functions of texts in communicative situations.

The absence of syntactic signs in animal communication may also be questioned in the case of visual communication, in which animals (when moving together in pairs or flocks, or fighting with each other, etc., including communication between specimens of different species, e.g., a predator and a prey) can coordinate their movements with a high level of precision. An animal's analysis of visual signs, which are represented by the other party's movements, may, in principle, include syntactic elements in addition to prosyntactic ones.

In the place of syntactic signs, an analogous function may be performed, e.g., by the differences in social status between communicating animals, or by a hierarchy of behavioural acts. This can be compared to the translation of an innovative text which has no analogues, and which can be marked by a sign (e.g., title, motto, introduction, or design) as guiding its perception.

References

Barnstone, Willis
1994 “Translation Theory with a Semiotic Slant”, *Semiotica* 102(1/2), 89–100.

Beaugrande, Robert de
1980 “Toward a Semiotic Theory of Literary Translating”. In: W. Wilss (ed.), *Semiotik und Übersetzen*, 23–43, Gunter Narr, Tübingen.

Bickerton, Derek
1990 *Language and Species*, The University of Chicago Press, Chicago.

Caws, Mary Ann
1986 “Literal or Liberal: Translating Perception”, *Critical Inquiry* 13(1).

Chomsky, Noam
1975 *Questions of Form and Interpretation*, The Peter de Ridder Press, Lisse.

Eco, Umberto
1988 “On Semiotics and Immunology”. In: E. E. Sercarz, F. Celada, N. A. Michison, T. Tada (eds.), *The Semiotics of Cellular Communication in the Immune System*, 3–15, Springer, Berlin.

Emmeche, Claus
1994 “The Computational Notion of Life”, *Theoria—Segunda Epoca* 9(21), 1–30.

Geigges, Werner, Jörg M. Herrmann
1993 “Endosemiosis”, *Semiotica* 96(1/2), 5–51.

Heyes, Cecilia M.
1993 “Imitation, Culture and Cognition”, *Animal Behaviour* 46, 999–1010.

Hjelmslev, Louis
1973 “A Causerie on Linguistic Theory”. In: L. Hjelmslev, *Essais Linguistiques* 2, Copenhagen, 101–117.

Hoffmeyer, Jesper
1996 *Signs of Meaning in the Universe*, Indiana University Press, Bloomington.

Hoffmeyer, Jesper
1997 “Molecular biology and heredity: semiotic aspects”. In: T. v. Uexküll (ed.), *Psychosomatic Medicine*, 43–50, Urban & Schwarzenberg, München.

Hoffmeyer, Jesper
2001a “Life and Reference”, *BioSystems* 60(1/3), 123–130.

Hoffmeyer, Jesper
2001b “Seeing Virtuality in Nature”, *Semiotica* 134(1/4), 381–398.

Hoffmeyer, Jesper, Claus Emmeche
1991 “Code-duality and the Semiotics of Nature”. In: M. Anderson, F. Merrell (eds.), *On Semiotic Modeling*, 117–166, Mouton de Gruyter, Berlin.

Holz-Mänttäri, Justa
1988 "Translation und das biologisch-soziale Gefuge". In: J. Holz Mänttäri (ed.), *Translationstheorie—Grundlagen und Standorte*, 39–57, Tamperen Yliopisto, Tampere.

Jablonka, Eva, Geva Rechav
1996 "The Evolution of Language in Light of the Evolution of Literacy". In: J. Trabant (ed.), *Origins of Language*, 70–88, Collegium Budapest, Budapest.

Jablonka, Eva, Marion Lamb, Avital Eytan
1998 " 'Lamarckian' Mechanisms in Darwinian Evolution", *Trends in Ecology and Evolution* 13(5), 206–210.

Kauffman, Stuart A.
1993 *The Origins of Order: Self-Organization and Selection in Evolution*, Oxford University Press, New York.

Kendrew, John, Eleanor Lawrence (eds.)
1994 *The Encyclopedia of Molecular Biology*, Blackwell Science, Oxford.

Kull, Kalevi
1998a "Organism as a Self-reading Text: Anticipation and Semiosis", *International Journal of Computing Anticipatory Systems* 1, 93–104.

Kull, Kalevi
1998b "Baerian Biology: Evolution by Means of Organisms' Interpretation". In: G. L. Farre, T. Oksala (eds.), *Emergence, Complexity, Hierarchy, Organization*, 197–200, Finnish Academy of Technology, Espoo.

Kull, Kalevi
1999a "Outlines for a Post-Darwinian Biology", *Folia Baeriana* 7, 129–142.

Kull, Kalevi
1999b "Copy *versus* translate, meme *versus* sign: development of biological textuality", *S, European Journal for Semiotic Studies* 12(1), 101–120.

Lotman, Juri
1978 "Fenomen kul'tury", *Trudy po Znakovym Sistemam* 10, 3–17.

Mertz, Elizabeth
1985 "Beyond Symbolic Anthropology: Introducing Semiotic Mediation". In: E. Mertz, R. J. Parmentier (eds.), *Semiotic Mediation: Sociocultural and Psychological Perspectives*, 1–19, Academic Press, Orlando.

Miklósi, Adam
1999 "The Ethological Analysis of Imitation", *Biological Reviews* 74(3), 347–374.

Posner, Roland
1987 "Charles Morris and the Behavioral Foundations of Semiotics". In: M. Krampen, K. Oehler, R. Posner, T. A. Sebeok, T. v. Uexküll (eds.), *Classics of Semiotics*, 23–57, Plenum Press, New York.

Quine, Willard van Orman
1959 "Meaning and Translation". In: R. A. Bower (ed.), *On Translation*, 148–172, Harvard University Press, Cambridge (Mass.).

Rocha, Luis
2001 "Evolution with Material Symbol Systems", *BioSystems* 60(1/3), 95–121.

Schulte, Rainer
1980 "Translation: An Interpretative Act through Visualization", *Pacific Moana Quarterly: An International Review of Arts and Ideas* 5(1).

Sebeok, Thomas A.
1989 *The Sign and its Masters*, University Press of America, Lanham.

Sebeok, Thomas A.
2001 "Biosemiotics: Its Roots, Proliferation, and Prospects", *Semiotica* 134(1/4), 61–78.

Stanosz, Barbara
1990 "Radical Translation, Actual Translation, and the Problem of Meaning", *Semiotica* 80(1/2), 81–88.

Torop, Peeter
1995 *Totalnyi Perevod*, Tartu Ülikooli Kirjastus, Tartu.

Torop, Peeter
1998 "The Limits of Translation: The Socio-Semiotic Aspect of Translation Semiotics", *Sign Systems Studies* 26, 136–150.

Uexküll, Jakob von
1940 *Bedeutungslehre*, Verlag von J. A. Barth, Leipzig.

Uexküll, Jakob von
1982 "The Theory of Meaning", *Semiotica* 42(1), 25–82.

Uexküll, Jakob von
1992 "A Stroll Through the Worlds of Animals and Men: A Picture Book of Invisible Worlds", *Semiotica* 89(4), 319–391.

Uexküll, Thure von
1987 "The Sign Theory of Jakob von Uexküll". In: M. Krampen, K. Oehler, R. Posner, T. A. Sebeok, T. v. Uexküll (eds.), *Classics of Semiotics*, 147–179, Plenum Press, New York.

Vehkavaara, Tommi
1998 "Extended Concept of Knowledge for Evolutionary Epistemology and for Biosemiotics: hierarchies of Storage and Subject of Knowledge". In: G. L. Farre, T. Oksala (eds.), *Emergence, Complexity, Hierarchy, Organization*, 207–216, Finnish Academy of Technology, Espoo.

Wilss, Wolfram
1988 *Kognition und Übersetzen: Zu Theorie und Praxis der menschlichen und der maschinellen Übersetzung*, Max Niemeyer Verlag, Tubingen.

Index