Archontan relations. Cladogram of archontan mammals, including the taxa discussed in the text.

its. Other pliastadiforms have claws on all digits, whereas euprimates have nails on all digits (primitively). Carpoleses thus appears to exhibit an intermediate condition, providing the first evidence for the transition from claws to nails in primates.

PERSPECTIVES: LINGUISTICS

Noam's Ark

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Language is naturally viewed as a unique feature of being human. Accordingly, the study of what language is —linguistics— has been very influential, primarily in the social and behavioral sciences. On page 1569 of this issue, Hauser, Chomsky and Fitch (1) expand the scope of language study with their demonstration that complex behaviors in animals and nonlinguistic behaviors in humans can inform our understanding of language evolution.

The origin of human language has been an esenatistic topic in the history of ideas for many centuries. It pops up in philosophical debates as a conceptual exercise on the nature of humanity and then, just as capriciously, disappears from the intellectual scene. Two principal ideas have been presented in these forays that emphasize the functional basis of language or alternatively its expression of humanity. For example, Rousseau (2) famously argued that language flows from emotions; shortly thereafter, Herder (3), a bit less famously, suggested that language is a special expression of human rationality. Of course, available theories of language and evolution vary underdetermined empirical answers. In desperation, the 19th century Linguistic Society of Paris banned the inconclusive topic of the origin of language.

Darwin inaugurated a new era by creating an empirical basis for what had been a purely conceptual debate. He suggested that language emerges from more primitive emotional communication abilities in animals. The notion that language is a gradually selected capability timidly appeared as Cartmill explained by new methods for studying morphological evolution that embraced comparative analyses of fossils and genetics. However, the best part of the 20th century contributed little to the subject because—as Hauser, Chomsky and Fitch point out—"linguistic behavior does not fossilize." Understanding the relation between genetics and behavior is still in its infancy, and has been complicated by the absence of a clear model that delineates what language itself is. Chomsky’s linguistic theory—which rede fined language as a cognitive computational faculty—afforded hope for a conceptually and empirically illuminating discussion of the evolution of language. In their review in this issue, Hauser et al. (1) sketch a broad programmatic outline of how to understand human language better by comparing its computational component to the computational capacities of our contemporary earthly cohabitants, the ones that survived the flood.

A brief dip into recent linguistic history will help us to understand the importance of the authors’ approach. Chomsky’s first great impact on behavioral science was his notion that sentence structure can be studied independently of meaning. His notorious demonstration of this is the sentence “Colorless green ideas sleep furiously” (4). Although it is nonsense, it is nontheless recognizable as a well-formed English sentence (compared, for example, with “Ideas green sleep furiously colorless”). The first step in the new linguistic science of sentence structure was to become more abstract, leaving behind meaning to study the pure laws of syntax.

This led to the formulation that even the simplest sentences have an inner “abstract” syntactic form. The problem for linguistic research became redefined: how the inner form is mapped onto the outer forms that
we hear and say. After 50 years of forming linguistic theories, Chomsky (5–7) now suggests that the essential mapping process can be reduced to two basic operations: merge and displacement. The first combines (lexical) units in a hierarchical structure, resulting in phrase structure trees that are relatively familiar; the second displaces a unit previously merged by merging it again at a different location in the structure and leaving a copy of it behind. This is illustrated by English sentences like "Mary, John likes [mary]" and "Who does John like [who]." Even though "Mary" and "Who" appear at the beginning of their respective sentences, they must be interpreted in their original merge positions (that is, after "likes" and "like," respectively).

The idea that an unconscious level of representation could be mapped at a conscious level set the field of language study (at that time largely populated by behavioral biologists, operationalists, and nominalists) on its ear. Next, the field of psycholinguistics sought to establish the psychological basis for Chomsky’s postulates of innate language structure and transformational grammar. This was accompanied by developments in allied “hybrid” disciplines such as neurolinguistics. (Neurolinguistics specifies the neurological mechanisms underlying different components of linguistic theory, and has moved from primary dependence on aphasic research to modern brain-imaging techniques.) Thus, linguistics research now centers on the capacities developed during childhood that could account for the richness and diversity of adult language, especially given the impoverished linguistic environments in which children are often nurtured. The complexity of what is acquired functionally and represented neurologically underlies the sometimes controversial claim that language is “innate,” a claim that will be enriched by Hauser et al.’s evolutionary perspective.

Two developments since Chomsky’s initial formulations of syntactic theory provide the theoretical underpinnings for Hauser et al.’s programmatic study of language evolution. The focus has shifted from describing factors manifest in external language (E-language) to describing abstract internal language (I-language) (8). Hauser and colleagues argue that what is at issue is not how language evolved to communicate or represent ideas, but rather how the central core of I-language computations can be delineated. They access the recent idea that I-language is essentially a “minimal” mapping between form and meaning, and can ultimately be reduced to an optimal set of processes. Thus, the study of syntax becomes the study of the immediate perfect “engine” driving syntactic computations—what the authors term “faculty of language in a narrow sense” (FLN). Other contributing biological features of language are relegated to the “faculty of language in the broad sense” (FLB).

So, what is at the center of this perfect engine of syntax? Hauser et al. crystallize a long-held intuition—that the essential process of syntax is recursion, the ability to generate an infinite array of expressions from a limited set of elements. Recursion appears in a wide range of human behaviors. For example, a childhood pastime defines the concept of “it” in a game of tag, namely, “the kid who was tagged by the kid” (who was tagged by the kid). Who was originally themselves tentatively point out that recursion may appear in other human activities, such as music, games, and social structures.

Chomsky’s theory is unparalleled among 20th-century theories of behavior, with the single exception of Freud’s metapsychological investigations. These two models of the mind have striking parallels, if one considers the computational architecture that psychodynamic theory postulated for the emotional expression of internal emotional representations. Both Freud and Chomsky showed the utility of a stable and structured unconscious level of representation. They suggested two similar core mechanisms for mapping it onto more explicit representations: association (Freud’s “Verdichtung,” Chomsky’s “merge”) and movement (Freud’s “Verschiebung,” Chomsky’s “displacement”). For Freud (10), dream elements are symbols that are sometimes united with their underlying themes, and sometimes displaced from them. In fact, even what Hauser et al. claim is language’s innermost syntactic property (recursion) has a small manifest echo in Lacan’s metapsychological theory (11).

This brings us back to Rousseau and Herder: Perhaps we see now a glimmer of unification among the notions that human symbolic representations have both an emotional and a computational component. What we may be working toward is a theory of the evolution of human expression in general. Whether this turns out to be a fruitful line of thought or not, Hauser et al. have taken the next step in presenting how we can empirically study the evolutionary basis of human language.

References and Notes