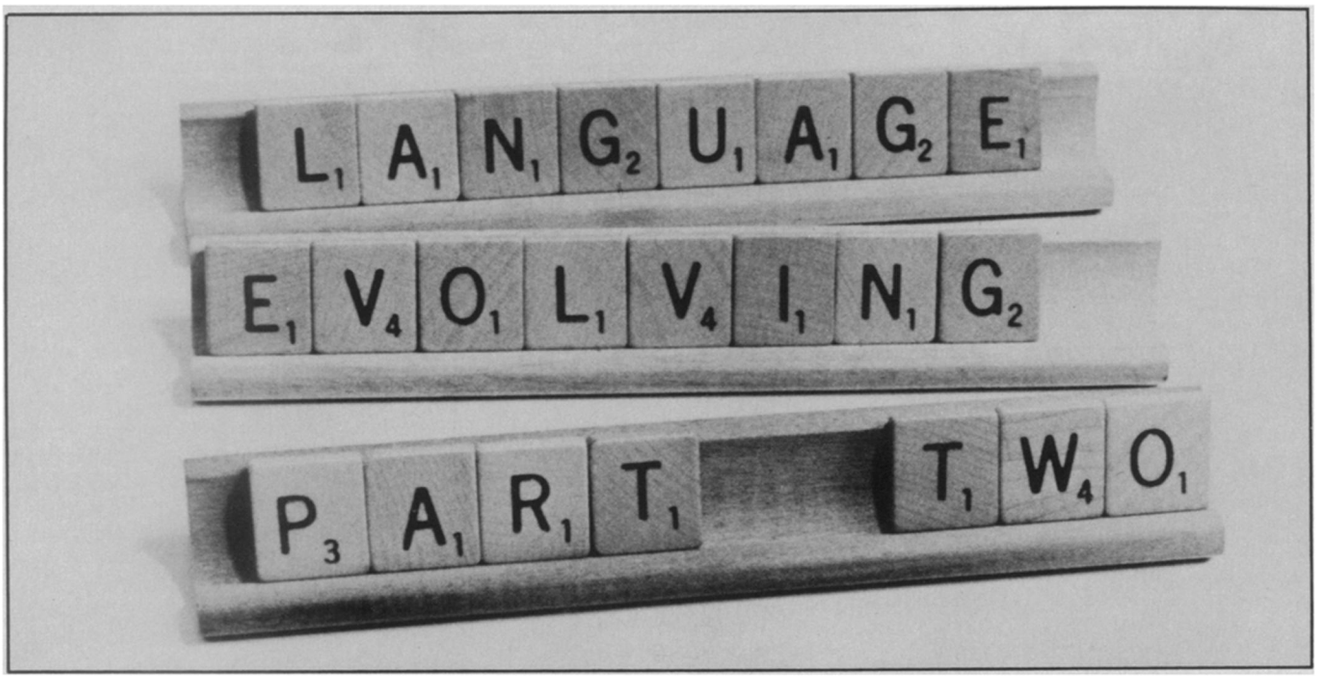


BY ROBERT J. TROTTER

Language probably began among the Neanderthals during the Fourth Glaciation. Modifiers may have preceded nouns and verbs.

Where, when and how did the human language ability originate? Archaeology can provide some of the most relevant answers to these questions. Anthropologist Ashley Montagu, for instance, suggests that a detailed study of toolmaking may yield clues to the cognitive processes of early humans and to the origin and evolution of language and speech. His thesis is that speech originated in the process of toolmaking, and he says that the variety of tools made by australopithecines indicates an ability to communicate at a level of abstraction requiring a medium such as speech.

At the New York Academy of Sciences' conference on the origin and evolution of language and speech, he explained how speech and toolmaking were probably tied in with the development of big game hunting—which is much more successful if the hunters can verbally signal changes in logistics and strategies. The three, speech, toolmaking and big game hunting, would probably have evolved with a sort of three-way feedback relationship leading to the further development of each. To verify such a theory, Montagu calls for a "scientific study of tools, a science as it may be called of hoplonology." (Oplon is Greek for tool or implement.)

If the toolmaking hypothesis is correct, then some form of speech could have been in use one or even two million years ago. But a study of tools and toolmaking may not, as Montagu suggests, prove the link between speech and tools. Princeton University psychologist Julian Jaynes, for one, believes that speech was not necessary for the transmission of such rudimentary skills as simple tool use and toolmaking from one generation to another. Indeed, he says, speech may have been a hindrance: "It is almost impossible to describe chopping off flints into simple choppers and hand axes in language. This act was transmitted solely by imitation in exactly the same way in which chimpanzees transmit the trick of inserting vine stems into ant hills to get ants. . . . In our own culture, it is doubtful if language is at all necessary in the transmission of such skills as swimming or riding a bicycle."

But Jaynes does have a theory of how language developed, and it is based on much more than the archaeological record. Up-to-date inputs from evolutionary theory, learning theory, behavioral processes, brain structure and environmental or ecological factors are all considered in his explanation.

When did speech evolve? To answer this and all questions about speech and language evolution, Jaynes says three factors must be taken into account: the survival value of speech, associated behavioral patterns and brain structure.

First of all, he says, we naively assume that speech is always beneficial. This is questionable. If a species is fully adapted to its ecological niche, it could perhaps be shown that a sudden ability to communicate syntactically would be disastrous. If the communication is vocal, it might attract predators. If by gestures, it might put its users in a vulnerable position (without the full use of their hands). But more important, a new form of communication might detract from the innate signaling mechanisms that have been successful in organizing the social grouping of the species.

It follows from such considerations, says Jaynes, that human language developed only during an era in which some portion of the human population was being persistently forced into new ecological niches to which it was not fully adapted. Any trait as universal in a species as language is, and with as precise a neurological basis as language has, must have developed during an age when it had a great and persisting survival value.

Behavioral patterns must also be taken into account because the ability to use and organize words into sentences must have resulted in very real behavioral changes. Learning theory helps explain this. To look at an object and name it at the same time allows a concentration upon it that otherwise would be absent. A child that can name colors will probably remember and recognize them better and will probably be better at using them. And just as the psychobehavioral development of a child leaps forward with speech, a similar leap must have occurred when humans as a species first developed language. Therefore, says Jaynes, "The development of language will result in behavioral sequelae whose artifacts we may find archaeologically."

Brain structure is the third consideration. The three cortical areas involved in language (supplementary motor cortex and Broca's area in the frontal lobe and Wernicke's area around the fissure of Sylvius) are more or less the same in contemporary speakers and may be assumed to have been necessary for the complete development of language as we speak it today. Getting information about the brains of early humans, however, is not easy. Jaynes admits that the validity of his views may rest upon the endocasts of

Neanderthal skulls yet to be discovered.

Endocasts (casts of the inside of skulls) are used to estimate the size and shape of the brains that formerly inhabited those skulls. The process has been used for many years, but more precise methods and measurements are now available, and information bearing on Jaynes's theory was presented at the meeting.

"The most striking and consistently present cerebral asymmetries found in adult and fetal brains," says Marjorie Le May of the Massachusetts General Hospital in Boston, "are in the region of the posterior end of the sylvian fissures—areas generally regarded as of major importance in language function." Le May's work suggests that this asymmetry was present in Neanderthal brains. One skull, the La-Chapelle-aux-Saints specimen, provides the evidence. If other Neanderthal skulls confirm Le May's conclusion, it may indicate that speech, or at least some of the speech areas of the brain, had begun to develop by the time of the Neanderthals—as Jaynes suggests.

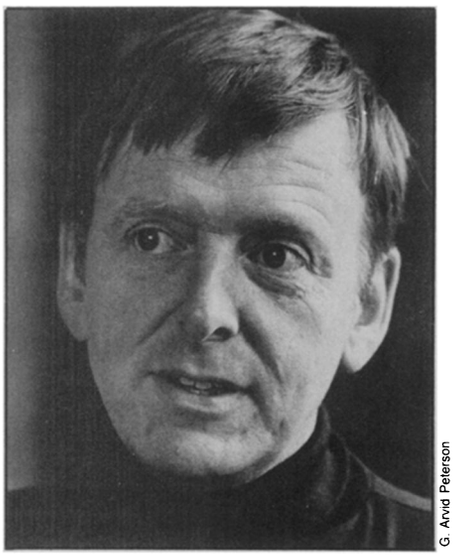
So when did speech evolve? The first factor Jaynes mentioned was survival value. So dramatic a development as speech, he says, had to coincide with significant ecological changes that would have forced severe changes in habits. The most obvious and dramatic ecological changes were probably a result of the great periods of glaciation. Each glaciation lasted about 70,000 years. The middle or coldest parts of each of these periods were 600,000; 400,000; 150,000, and 35,000 years ago. The warm interglacial periods were without sufficient ecological challenge to provide language with a necessary survival value, so Jaynes rules them out as times of speech development.

He further rules out the first two glacial periods because at the time the major hominid populations were still in Africa and removed from the effects of glaciation. The third period is ruled out for other, more subtle reasons. The hominid race at that time, *Homo erectus*, used tools, lived in caves and hunted big game. But the brain of this creature, says Jaynes, had not evolved to the size and structure assumed necessary for the complete development of language. In addition, he says, their tools were too crude and primitive. Jaynes says the hominids of this time (150,000 years ago) "communicated just like all other primates, with an abundance of visual, vocal and tactile signals that were very far removed from the syntactical language we practice today."

That leaves the Fourth Glaciation as the time during which speech evolved and developed. This began about 70,000 years ago, reached its coldest period about 35,000 years ago, and slowly receded to normal by around 10,000 years ago. During this time, the late Neanderthalers were part of a general human line that had great variation, a variation that allowed for an increasing pace of evolution as nomadic tribes traveled over wide distances and into new ecological niches.

"These considerations then," says Jaynes, "fulfill the three constraints we have placed upon the solution." The climate provided a theater of sufficient selective pressure so that a communication system, such as language, would have considerable value. The behavioral changes were evident in an explosion of new and different tools about 40,000 B.C. And third, the brain, especially the frontal lobes and possibly the speech area, had increased in size and proportion to the extent that a language ability would probably have been neurologically possible.

Where did all of this happen? The same three constraints suggest an answer. The most likely place for speech to have developed, says Jaynes, was in the north temperate zone in a band from France and Spain across Europe, North Africa, the Near East and Asia and from there spreading southward.



G. Arvid Peterson

Jaynes: Three factors in speech origin.

How did speech begin? Once again Jaynes is not at a loss for an answer, though he does caution that he is painting in the broadest strokes possible and notes that what he is describing is an ideal or working model of which there may be variants. It is intended, he says, to provoke a new kind of thinking about the development of language and speech.

Speech may have begun, as Condillac suggested, with the "language of action." It is known that the brain's limbic system is responsible for most of the vocal cries of present-day subhuman primates. The entire vocal repertoires of rhesus and squirrel monkeys, for example, can be elicited by electrical stimulation of points throughout the limbic circuit. This suggests that the vocal calls of early hominids were probably controlled by the limbic system. The transfer of control of vocalization from the limbic system to the cortex had to be an important step in the evolution of speech. Such a transfer would probably have made possible intentional vocalization, as opposed to the instinctive and emotional cries produced by the limbic system.

Ronald E. Myers of the National Institutes of Health studies the neurology of vocalization and speech. He reports that lesions of areas of the cortex that correspond to human speech areas fail to impair vocalization in the monkey. This implies that human speech cannot be considered simply as an elaboration of the vocal responses of lower primates (limbic output), but that it evolved quite independently and serves a different purpose.

The area of the cortex that evolved in connection with speech appears to be mainly in the left hemisphere. A possible explanation comes from Horst D. Steklis and Stephen R. Harnad of Rutgers University. They say there is no evidence for anything like cerebral dominance in most of the lower primates. This was probably also true of the earliest hominids. The first evidence for handedness, they say, comes with tool use and weapon use by *Australopithecus*. There is evidence that the majority of these tools were chopped by right-handed individuals. The fine motor control of the right hand, as is known, is linked to the left hemisphere of the brain. Advances in toolmaking and fine motor control would have lead to further cerebral asymmetry. "Fine motor control being already lateralized," the researchers say, "linguistic elaboration also occurred on the more specialized side."

What ecological pressures were responsible for the switch in intentional signaling from the visual-gestural to the auditory-vocal channel? As populations migrated out of Africa into the northern climates, visual signals became less effective for a variety of reasons, says Jaynes. Dark caves and hunting by night made visual signals almost useless. Tool use made it important to free the hands and body for increasingly complicated activities. "It is therefore plausible that incidental vocal signals under these persisting pressures took on the intentional function that was formerly the property of visual signals only. This was a momentous step, and probably had a long evolution which was not complete until the end of the Middle Pleistocene and the approach of the Fourth Glaciation."

By then, our ancestors may have been ready to begin talking. The first real elements of speech, suggests Jaynes, were the endings of intentional cries first varying simply by intensity and then being differentiated further. Imagine a cave dweller screaming "wahee!" at the approach of a saber-toothed tiger. The intensity of such a signal would probably naturally correspond to the intensity of the danger—perhaps in its ending phoneme. A tiger far off might result in a cry of much less intensity and develop a different ending such as the more relaxed

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. . . Language

"wahoo." It is these endings, then, that become the first modifiers meaning near and far. And the next step toward syntactic language would be separating the endings from a particular cry and attaching them to another with the same indication.

The age of modifiers, in Europe, says Jaynes, probably lasted until about 46,000 B.C. This estimate is based on the development of Neanderthal skulls.

After the age of modifiers came the age of commands. Modifiers separated from the cries they modified could have become commands. The new cry of "ee!" shouted to someone could mean "come nearer," while "o!" could mean "go farther." The advantage of such commands to hunting groups is obvious.

Jaynes goes on to explain how inflectional questioning and negation may have developed. He moves from there to the development of nouns (for animals) between 25,000 B.C. and 15,000 B.C. Archaeological data help provide the dates. The age of modifiers coincided with the making of superior tools ("sharper" may have been a useful modifier). The age of nouns coincides with the drawing of animals on the walls of caves. After animal or life nouns came thing nouns. This coincides with the invention of pottery, pendants and ornaments. Names for people came next. Once such names are available, individuals can be thought about or recreated in their absence. This may have developed between 10,000 and 8,000 B.C. when ceremonial graves began to appear. Just as a noun for an animal makes that relationship a much more intense one, so does a name. And when a named person dies, the name still goes on, hence, burial practices and mourning.

Jaynes discusses verbs, prepositions, other parts of speech and syntax and presents explanations for how all of them could have developed during the relatively short time span of 70,000 years.

Finally Jaynes compares his theory with that of others: "The main features of the model that I have presented are in contrast to most previous proposals about the origin of language. All previous theories have placed it historically at least a million years ago and its place of origin as Africa. . . . Previous models all emphasize nouns as coming first. But a central feature of the present theory is that modifiers not only preceded everything else, but necessarily had to do so until they were stabilized into commands before they could be relaxed into nouns."

Jaynes's theory, like all others, contains a certain amount of conjecture. But with increasing evidence from a variety of fields (like that presented at the New York meeting), successive theories will contain less and less conjecture. We will know more and more about the nature of language—and all that it implies about the nature of humanity. □