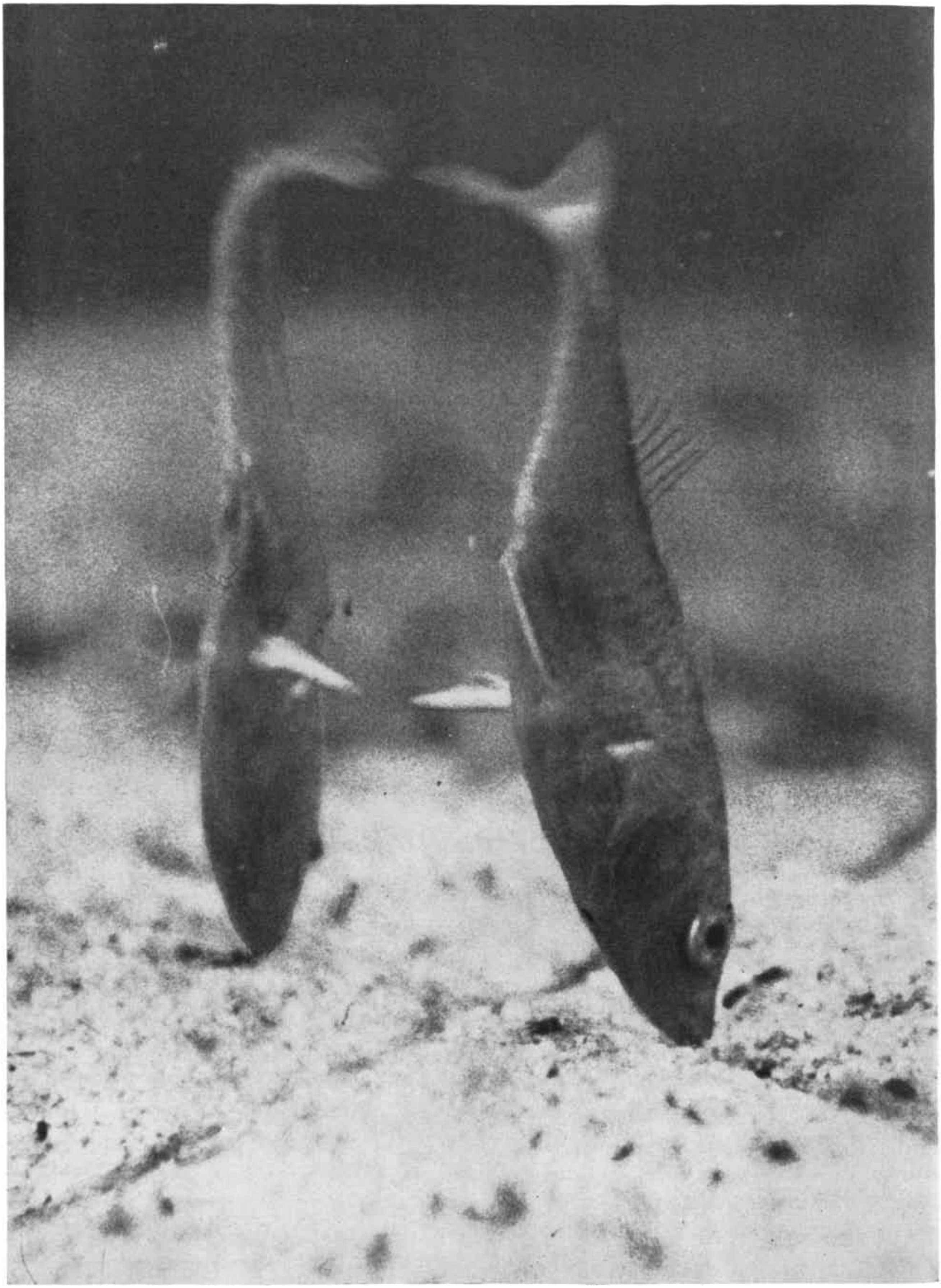


THREAT POSTURE of male stickleback is example of nonvocal communication in lower animals. In this picture, made by N. Tinbergen of the University of Oxford, the fish is responding to its mirror image by indicating readiness to fight "intruding" male.

The Origin of Speech

Man is the only animal that can communicate by means of abstract symbols. Yet this ability shares many features with communication in other animals, and has arisen from these more primitive systems

by Charles F. Hockett

About 50 years ago the Linguistic Society of Paris established a standing rule barring from its sessions papers on the origin of language. This action was a symptom of the times. Speculation about the origin of language had been common throughout the 19th century, but had reached no conclusive results. The whole enterprise in consequence had come to be frowned upon—as futile or crackpot—in respectable linguistic and philological circles. Yet amidst the speculations there were two well-reasoned empirical plans that deserve mention even though their results were negative.

A century ago there were still many corners of the world that had not been visited by European travelers. It was reasonable for the European scholar to suspect that beyond the farthest frontiers there might lurk half-men or man-apes who would be "living fossils" attesting to earlier stages of human evolution. The speech (or quasi-speech) of these men (or quasi-men) might then similarly attest to earlier stages in the evolution of language. The search was vain. Nowhere in the world has there been discovered a language that can validly and meaningfully be called "primitive." Edward Sapir wrote in 1921: "There is no more striking general fact about language than its universality. One may argue as to whether a particular tribe engages in activities that are worthy of the name of religion or of art, but we know of no people that is not possessed of a fully developed language. The lowliest South African Bushman speaks in the forms of a rich symbolic system that is in essence perfectly comparable to the speech of the cultivated Frenchman."

The other empirical hope in the 19th century rested on the comparative method of historical linguistics, the discovery of which was one of the triumphs of the period. Between two languages the resemblances are sometimes so extensive and orderly that they cannot be attributed to chance or to parallel development. The alternative explanation is that the two are divergent descendants of a single earlier language. English, Dutch, German and the Scandinavian languages are related in just this way. The comparative method makes it possible to examine such a group of related languages and to construct, often in surprising detail, a portrayal of the common ancestor, in this case the proto-Germanic language. Direct documentary evidence of proto-Germanic does not exist, yet understanding of its workings exceeds that of many languages spoken today.

There was at first some hope that the comparative method might help determine the origin of language. This hope was rational in a day when it was thought that language might be only a few thousands or tens of thousands of years old, and when it was repeatedly being demonstrated that languages that had been thought to be unrelated were in fact related. By applying the comparative method to all the languages of the world, some earliest reconstructable horizon would be reached. This might not date back so early as the origin of language, but it might bear certain earmarks of primitiveness, and thus it would enable investigators to extrapolate toward the origin. This hope also proved vain. The earliest reconstructable stage for any language family shows all the complexities and flexibilities of the languages of today.

These points had become clear a half-century ago, by the time of the Paris ruling. Scholars cannot really approve of such a prohibition. But in this instance it had the useful result of channeling the energies of investigators toward the gathering of more and better information about languages as they are today. The subsequent progress in understanding the workings of language has been truly remarkable. Various related fields have also made vast strides in the last half-century: zoologists know more about the evolutionary process, anthropologists know more about the nature of culture, and so on. In the light of these developments there need be no apology for reopening the issue of the origins of human speech.

Although the comparative method of linguistics, as has been shown, throws no light on the origin of language, the investigation may be furthered by a comparative method modeled on that of the zoologist. The frame of reference must be such that all languages look alike when viewed through it, but such that within it human language as a whole can be compared with the communicative systems of other animals, especially the other hominoids, man's closest living relatives, the gibbons and great apes. The useful items for this sort of comparison cannot be things such as the word for "sky"; languages have such words, but gibbon calls do not involve words at all. Nor can they be even the signal for "danger," which gibbons do have. Rather, they must be the basic features of design that can be present or absent in any communicative system, whether it be a communicative system of humans, of animals or of machines.

With this sort of comparative method it may be possible to reconstruct the communicative habits of the remote ancestors of the hominoid line, which may be called the protohominoids. The task, then, is to work out the sequence by which that ancestral system became language as the hominids—the man-apes and ancient men—became man.

A set of 13 design-features is presented in the illustration on the opposite page. There is solid empirical justification for the belief that all the languages of the world share every one of them. At first sight some appear so trivial that no one looking just at language would bother to note them. They become worthy of mention only when it is realized that certain animal systems—and certain human systems other than language—lack them.

The first design-feature—the "vocal-auditory channel"—is perhaps the most obvious. There are systems of communication that use other channels; for example, gesture, the dancing of bees or the courtship ritual of the stickleback. The vocal-auditory channel has the advantage—at least for primates—that it leaves much of the body free for other activities that can be carried on at the same time.

The next two design-features—"rapid fading" and "broadcast transmission and directional reception," stemming from the physics of sound—are almost unavoidable consequences of the first. A linguistic signal can be heard by any auditory system within earshot, and the source can normally be localized by binaural direction-finding. The rapid fading of such a signal means that it does not linger for reception at the hearer's convenience. Animal tracks and spoors, on the other hand, persist for a while; so of course do written records, a product of man's extremely recent cultural evolution.

The significance of "interchangeability" and "total feedback" for language becomes clear upon comparison with other systems. In general a speaker of a language can reproduce any linguistic message he can understand, whereas the characteristic courtship motions of the male and female stickleback are different, and neither can act out those appropriate to the other. For that matter in the communication of a human mother and infant neither is apt to transmit the characteristic signals or to manifest the typical responses of the other. Again, the speaker of a language hears, by total feedback, everything of linguistic relevance in what he himself says. In contrast, the male stickleback does not see the colors of his own eye and belly that are crucial in stimulating the female. Feedback is important, since it makes possible the so-called internalization of communicative behavior that constitutes at least a major portion of "thinking."

The sixth design-feature, "specialization," refers to the fact that the bodily effort and spreading sound waves of speech serve no function except as signals. A dog, panting with his tongue hanging out, is performing a biologically essential activity, since this is how dogs cool themselves off and maintain the proper body temperature. The panting dog incidentally produces sound, and thereby may inform other dogs (or humans) as to where he is and how he feels. But this transmission of information is strictly a side effect. Nor does the dog's panting exhibit the design-feature of "semanticity." It is not a signal meaning that the dog is hot; it is part of being hot. In language, however, a message triggers the particular result it does because there are relatively fixed associations between elements in messages (*e.g.*, words) and recurrent features or situations of the world around us. For example, the English word "salt" means salt, not sugar or pepper. The calls of gibbons also possess semanticity. The gibbon has a danger call, for example, and it does not in principle matter that the meaning of the call is a great deal broader and more vague than, say, the cry of "Fire!"

In a semantic communicative system the ties between meaningful message-elements and their meanings can be arbitrary or nonarbitrary. In language the ties are arbitrary. The word "salt" is not salty nor granular; "dog" is not "canine"; "whale" is a small word for a large object; "microorganism" is the reverse. A picture, on the other hand, looks like what it is a picture of. A bee dances faster if the source of nectar she is reporting is closer, and slower if it is farther away. The design-feature of "arbitrariness" has the disadvantage of being arbitrary, but the great advantage that there is no limit to what can be communicated about.

Human vocal organs can produce a huge variety of sound. But in any one language only a relatively small set of ranges of sound is used, and the differences between these ranges are functionally absolute. The English words "pin" and "bin" are different to the ear only at one point. If a speaker produces a syllable that deviates from the normal pronunciation of "pin" in the direction of that of "bin," he is not producing still a third word, but just saying "pin" (or perhaps "bin") in a noisy way. The hearer compensates if he can, on the basis of context, or else fails to understand. This feature of "discreteness" in the elementary signaling units of a language contrasts with the use of sound effects by way of vocal gesture. There is an effectively continuous scale of degrees to which one may raise his voice as in anger, or lower it to signal confidentiality. Bee-dancing also is continuous rather than discrete.

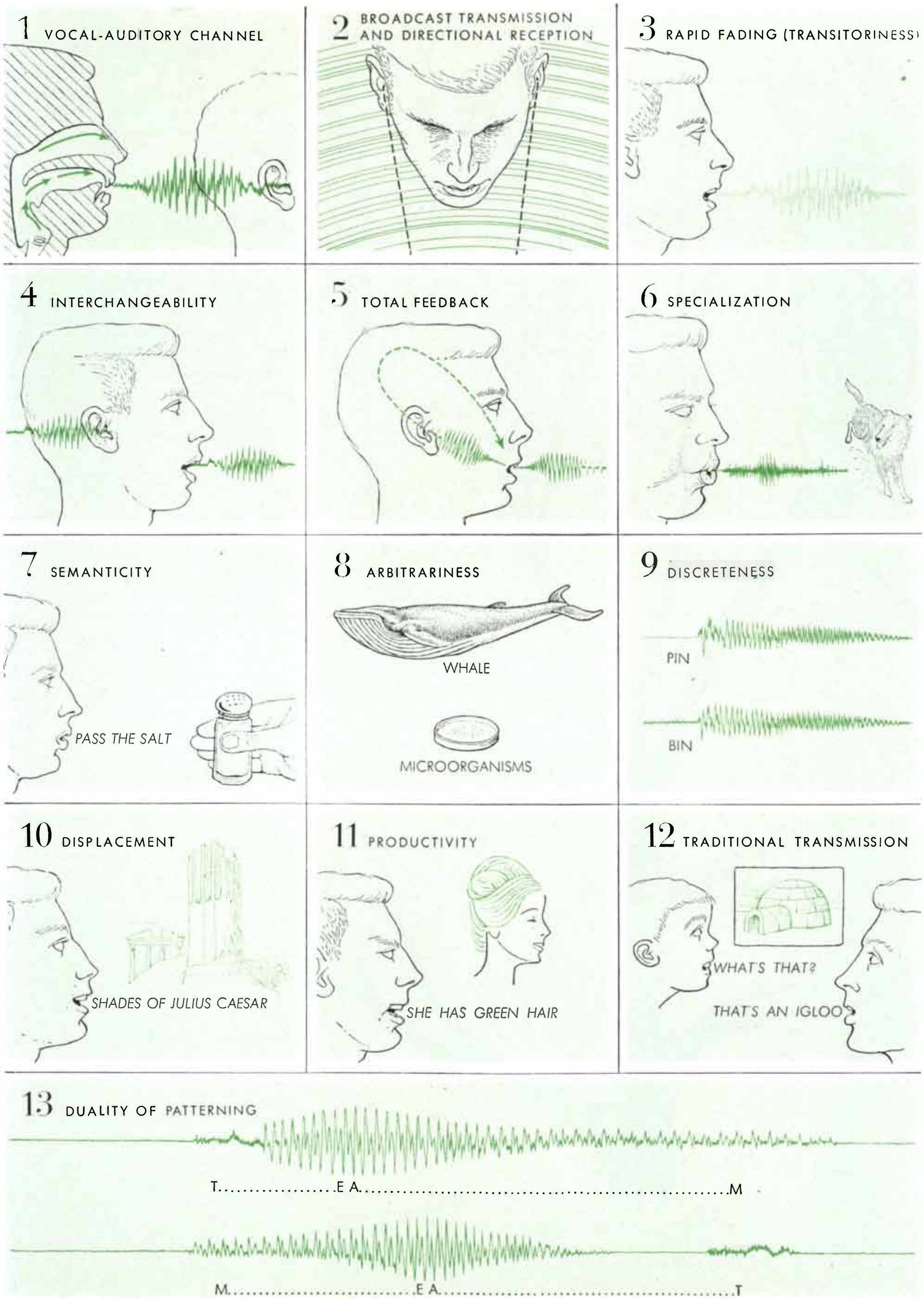
Man is apparently almost unique in being able to talk about things that are remote in space or time (or both) from where the talking goes on. This feature—"displacement"—seems to be definitely lacking in the vocal signaling of man's closest relatives, though it does occur in bee-dancing.

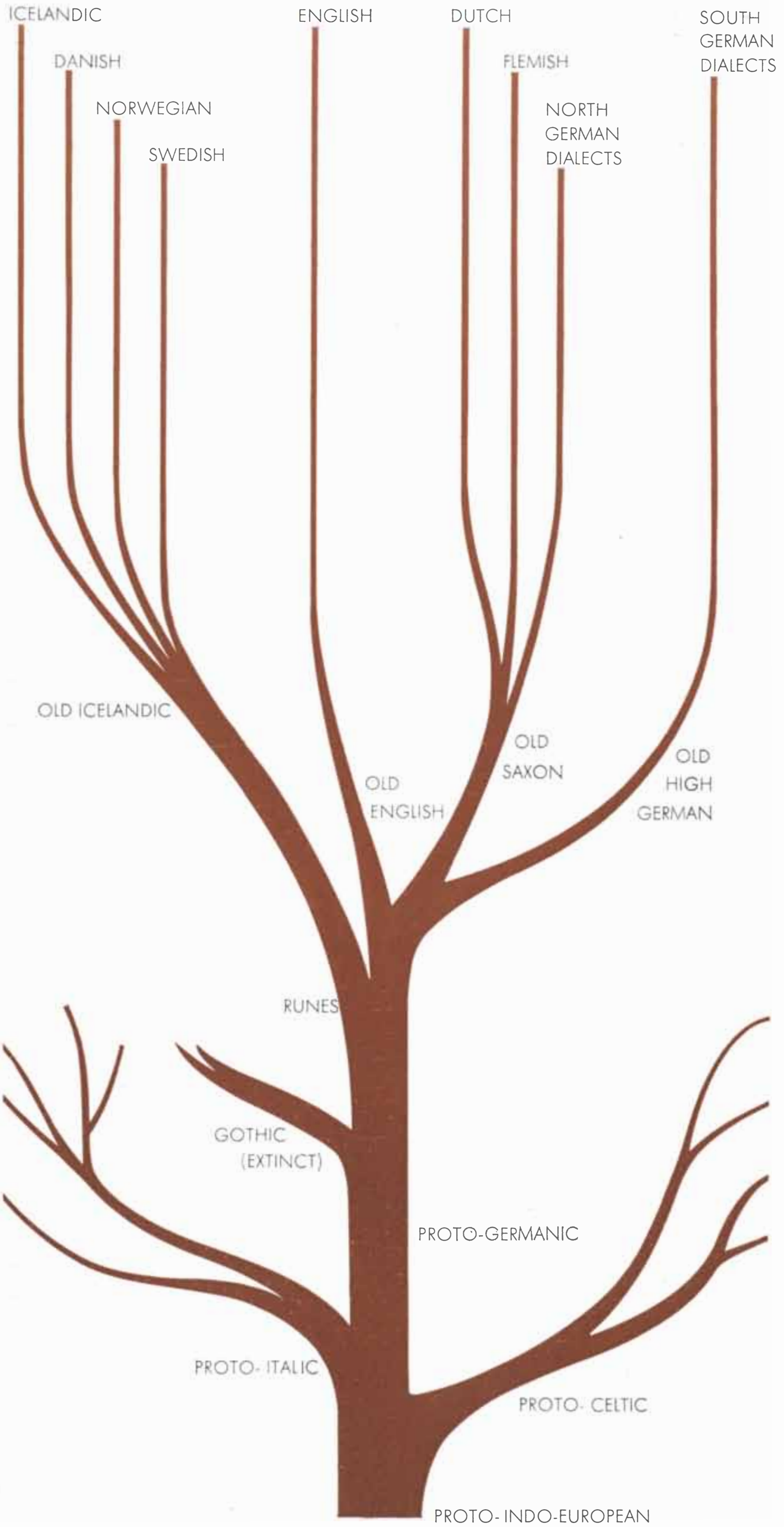
One of the most important design-features of language is "productivity"; that is, the capacity to say things that have never been said or heard before and yet to be understood by other speakers of the language. If a gibbon makes any vocal sound at all, it is one or another of a small finite repertory of familiar calls. The gibbon call system can be characterized as closed. Language is open, or "productive," in the sense that one can coin new utterances by putting together pieces familiar from old utterances, assembling them by patterns of arrangement also familiar in old utterances.

Human genes carry the capacity to acquire a language, and probably also a strong drive toward such acquisition, but the detailed conventions of any one language are transmitted extragenetically by learning and teaching. To what extent such "traditional transmission" plays a part in gibbon calls or for other mammalian systems of vocal signals is not known, though in some instances the uniformity of the sounds made by a species, wherever the species is found over the world, is so great that genetics must be responsible.

The meaningful elements in any language—"words" in everyday parlance, "morphemes" to the linguist—constitute an enormous stock. Yet they are represented by small arrangements of a relatively very small stock of distinguishable sounds which are in themselves wholly meaningless. This "duality of patterning" is illustrated by the English words

THIRTEEN DESIGN-FEATURES of animal communication, discussed in detail in the text of this article, are symbolized on opposite page. The patterns of the words "pin," "bin," "team" and "meat" were recorded at Bell Telephone Laboratories.


1 VOCAL-AUDITORY CHANNEL
2 BROADCAST TRANSMISSION AND DIRECTIONAL RECEPTION
3 RAPID FADING (TRANSITORINESS)
4 INTERCHANGEABILITY
5 TOTAL FEEDBACK
6 SPECIALIZATION
7 SEMANTICITY
PASS THE SALT
8 ARBITRARINESS
WHALE
MICROORGANISMS
9 DISCRETENESS
PIN
BIN
10 DISPLACEMENT
SHADES OF JULIUS CAESAR
11 PRODUCTIVITY
SHE HAS GREEN HAIR
12 TRADITIONAL TRANSMISSION
WHAT'S THAT?
THAT'S AN IGLOO
13 DUALITY OF PATTERNING
T..................E A..M
M..............................E A...T



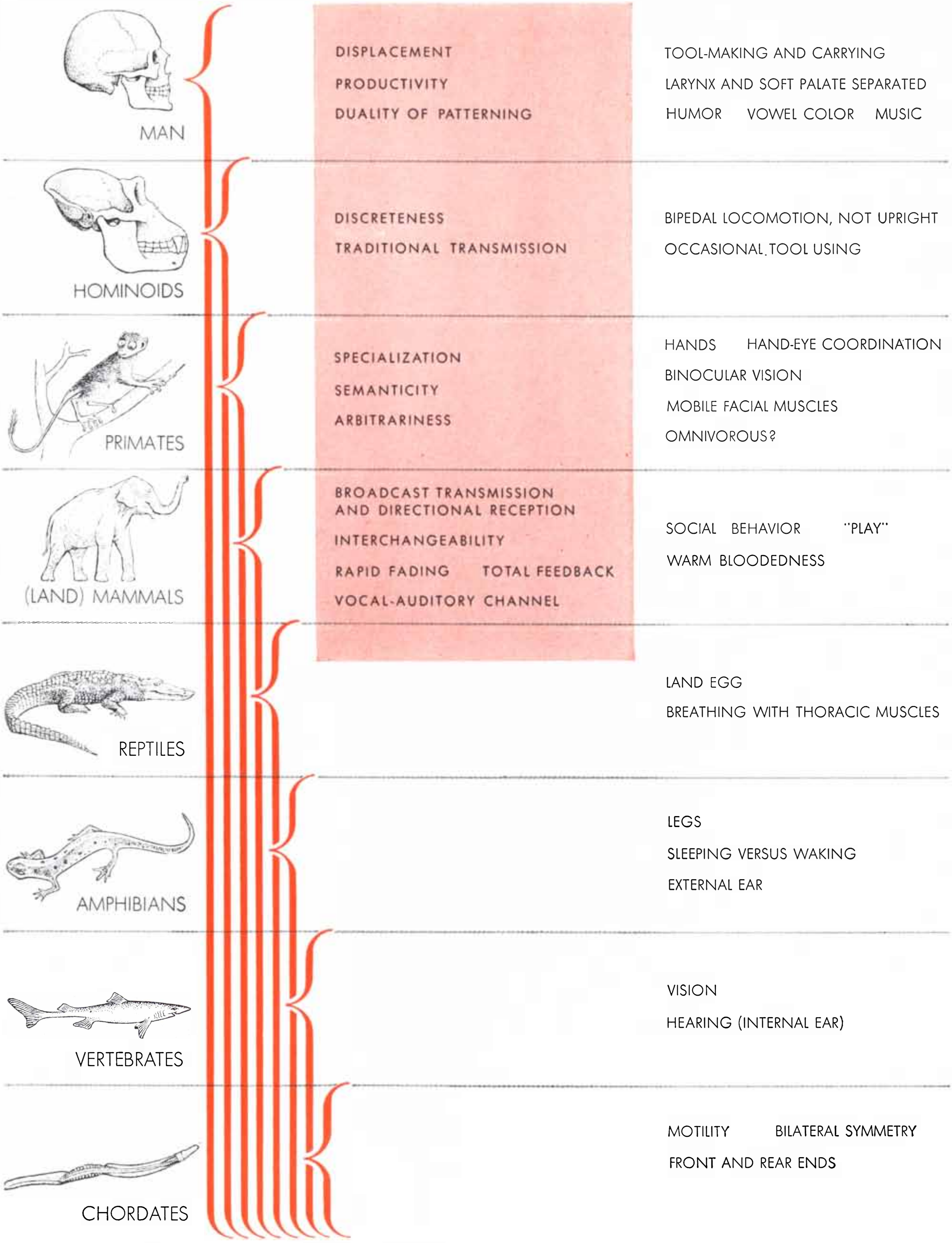
ORIGIN OF MODERN GERMANIC LANGUAGES, as indicated by this "family tree," was proto-Germanic, spoken some 2,700 years ago. Comparison of present-day languages has provided detailed knowledge of proto-Germanic, although no direct documentary evidence for the language exists. It grew, in turn, from the proto-Indo-European of 5000 B.C. Historical studies cannot, however, trace origins of language back much further in time.

"tack," "cat" and "act." They are totally distinct as to meaning, and yet are composed of just three basic meaningless sounds in different permutations. Few animal communicative systems share this design-feature of language—none among the other hominoids, and perhaps none at all.

It should be noted that some of these 13 design-features are not independent. In particular, a system cannot be either arbitrary or nonarbitrary unless it is semantic, and it cannot have duality of patterning unless it is semantic. It should also be noted that the listing does not attempt to include all the features that might be discovered in the communicative behavior of this or that species, but only those that are clearly important for language.

It is probably safe to assume that nine of the 13 features were already present in the vocal-auditory communication of the protohominoids—just the nine that are securely attested for the gibbons and humans of today. That is, there were a dozen or so distinct calls, each the appropriate vocal response (or vocal part of the whole response) to a recurrent and biologically important type of situation: the discovery of food, the detection of a predator, sexual interest, need for maternal care, and so on. The problem of the origin of human speech, then, is that of trying to determine how such a system could have developed the four additional properties of displacement, productivity and full-blown traditional transmission. Of course the full story involves a great deal more than communicative behavior alone. The development must be visualized as occurring in the context of the evolution of the primate horde into the primitive society of food-gatherers and hunters, an integral part, but a part, of the total evolution of behavior.

It is possible to imagine a closed system developing some degree of productivity, even in the absence of the other three features. Human speech exhibits a phenomenon that could have this effect, the phenomenon of "blending." Sometimes a speaker will hesitate between two words or phrases, both reasonably appropriate for the situation in which he is speaking, and actually say something that is neither wholly one nor wholly the other, but a combination of parts of each. Hesitating between "Don't shout so loud" and "Don't yell so loud," he might come out with "Don't shell so loud." Blending is almost always involved in slips of the tongue, but it may



EVOLUTION OF LANGUAGE and some related characteristics are suggested by this classification of chordates. The lowest form of animal in each classification exhibits the features listed at the right of the class. Brackets indicate that each group possesses or has evolved beyond the characteristics exhibited by all the groups below. The 13 design-features of language appear in the colored rectangle. Some but by no means all of the characteristics associated with communication are presented in the column at right.

also be the regular mechanism by which a speaker of a language says something that he has not said before. Anything a speaker says must be either an exact repetition of an utterance he has heard before, or else some blended product of two or more such familiar utterances. Thus even such a smooth and normal sentence as "I tried to get there, but the car broke down" might be produced as a blend, say, of "I tried to get there but couldn't" and "While I was driving down Main Street the car broke down."

Children acquiring the language of their community pass through a stage that is closed in just the way gibbon calls are. A child may have a repertory of several dozen sentences, each of which, in adult terms, has an internal structure, and yet for the child each may be an indivisible whole. He may also learn new whole utterances from surrounding adults. The child takes the crucial step, however, when he first says something that he has not learned from others. The only way in which the child can possibly do this is by blending two of the whole utterances that he already knows.

In the case of the closed call-system of the gibbons or the protohominoids, there is no source for the addition of new unitary calls to the repertory except perhaps by occasional imitation of the calls and cries of other species. Even this would not render the system productive, but would merely enlarge it. But blending might occur. Let AB represent the food call and CD the danger call, each a fairly complex phonetic pattern. Suppose a protohominoid encountered food and caught sight of a predator at the same time. If the two stimuli were balanced just right, he might emit the calls ABCD or CDAB in quick sequence, or might even produce AD or CB. Any of these would be a blend. AD, for example, would mean "both food and danger." By

	A SOME GRYLLIDAE AND TETTIGONIIDAE	B BEE DANCING	C STICKLEBACK COURTSHIP	D WESTERN MEADOWLARK SONG
1 THE VOCAL-AUDITORY CHANNEL	AUDITORY, NOT VOCAL	NO	NO	YES
2 BROADCAST TRANSMISSION AND DIRECTIONAL RECEPTION	YES	YES	YES	YES
3 RAPID FADING (TRANSITORINESS)	YES, REPEATED	?	?	YES
4 INTERCHANGEABILITY	LIMITED	LIMITED	NO	?
5 TOTAL FEEDBACK	YES	?	NO	YES
6 SPECIALIZATION	YES?	?	IN PART	YES?
7 SEMANTICITY	NO?	YES	NO	IN PART ?
8 ARBITRARINESS	?	NO		IF SEMANTIC, YES
9 DISCRETENESS	YES?	NO	?	?
10 DISPLACEMENT		YES, ALWAYS		?
11 PRODUCTIVITY	NO	YES	NO	?
12 TRADITIONAL TRANSMISSION	NO?	PROBABLY NOT	NO?	?
13 DUALITY OF PATTERNING	? (TRIVIAL)	NO		?

EIGHT SYSTEMS OF COMMUNICATION possess in varying degrees the 13 design-features of language. Column A refers to members of the cricket family. Column H concerns only Western music since the time of Bach. A question mark means that it is virtue of this, AB and CD would acquire new meanings, respectively "food without danger" and "danger without food." And all three of these calls—AB, CD and AD—would now be composite rather than unitary, built out of smaller elements with their own individual meanings: A would mean "food"; B, "no danger"; C, "no food"; and D, "danger."

But this is only part of the story. The generation of a blend can have no effect unless it is understood. Human beings are so good at understanding blends that it is hard to tell a blend from a rote repetition, except in the case of slips of the tongue and some of the earliest and most tentative blends used by children. Such powers of understanding cannot be ascribed to man's prehuman ancestors. It must be supposed, therefore, that occasional blends occurred over many tens of thousands of years (perhaps, indeed, they still may occur from time to time among gibbons or the great apes), with rarely any appropriate communicative impact on hearers, before the understanding of blends became speedy enough to reinforce their production. However, once that did happen, the earlier closed system had become open and productive.

It is also possible to see how faint traces of displacement might develop in a call system even in the absence of productivity, duality and thoroughgoing traditional transmission. Suppose an early hominid, a man-ape say, caught sight of a predator without himself being seen. Suppose that for whatever reason—perhaps through fear—he sneaked silently back toward others of his band and only a bit later gave forth the danger call. This might give the whole band a better chance to escape the predator, thus bestowing at least slight survival value on whatever factor was responsible for the delay.

Something akin to communicative displacement is involved in lugging a stick or a stone around—it is like talking today about what one should do tomorrow. Of course it is not to be supposed that the first tool-carrying was purposeful, any more than that the first displaced communication was a discussion of plans. Caught in a *cul-de-sac* by a predator, however, the early hominid might strike out in terror with his stick or stone and by chance disable or drive off his enemy. In other words, the first tool-carrying had a consequence but not a purpose. Because the outcome was fortunate, it tended to reinforce whatever factor, genetic or traditional, prompted the behavior and made the outcome possible. In the end such events do lead to purposive behavior.

Although elements of displacement might arise in this fashion, on the whole it seems likely that some degree of productivity preceded any great proliferation of communicative displacement as well as any significant capacity for traditional transmission. A productive system requires the young to catch on to the ways in which whole signals are built out of smaller meaningful elements, some of which may never occur as whole signals in isolation. The young can do this only in the way that human children learn their language: by learning some utterances as whole units, in due time testing various blends based on that repertory, and finally adjusting their patterns of blending until the bulk of what they say matches what adults would say and is therefore understood. Part of this learning process is bound to take place away from the precise situations for which the responses are basically appropriate, and this means the promotion of displacement. Learning and teaching, moreover, call on any capacity for traditional transmission that the band may have. Insofar as the communicative system itself has survival value, all this bestows survival value also on the capacity

E GIBBON CALLS	F PARALINGUISTIC PHENOMENA	G LANGUAGE	H INSTRUMENTAL MUSIC
YES	YES	YES	AUDITORY, NOT VOCAL
YES	YES	YES	YES
YES, REPEATED	YES	YES	YES
YES	LARGELY YES	YES	?
YES	YES	YES	YES
YES	YES?	YES	YES
YES	YES?	YES	NO (IN GENERAL)
YES	IN PART	YES	
YES	LARGELY NO	YES	IN PART
NO	IN PART	YES, OFTEN	
NO	YES	YES	YES
?	YES	YES	YES
NO	NO	YES	

doubtful or not known if the system has the particular feature. A blank space indicates that feature cannot be determined because another feature is lacking or is indefinite.

for traditional transmission and for displacement. But these in turn increase the survival value of the communicative system. A child can be taught how to avoid certain dangers before he actually encounters them.

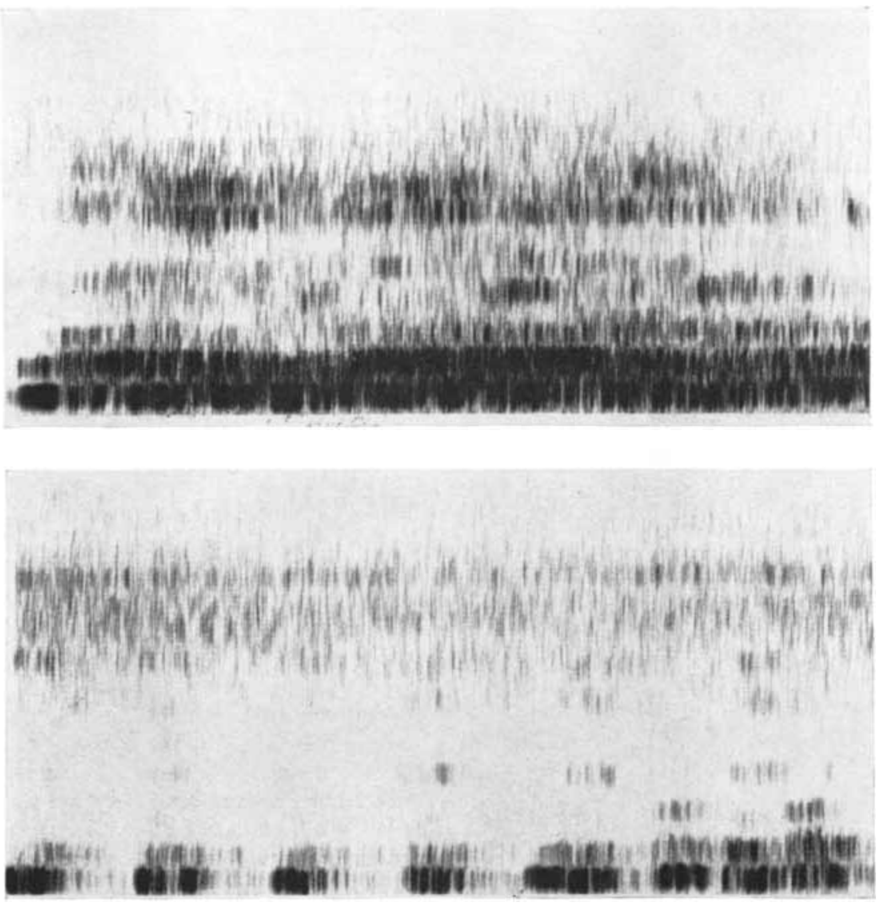
These developments are also necessarily related to the appearance of large and convoluted brains, which are better storage units for the conventions of a complex communicative system and for other traditionally transmitted skills and practices. Hence the adaptative value of the behavior serves to select genetically for the change in structure. A lengthened period of childhood helplessness is also a longer period of plasticity for learning. There is therefore selection for prolonged childhood and, with it, later maturity and longer life. With more for the young to learn, and with male as well as female tasks to be taught, fathers become more domesticated. The increase of displacement promotes retention and foresight; a male can protect his mate and guard her jealously from other males even when he does not at the moment hunger for her.

There is excellent reason to believe that duality of patterning was the last property to be developed, because one can find little if any reason why a communicative system should have this property unless it is highly complicated. If a vocal-auditory system comes to have a larger and larger number of distinct meaningful elements, those elements inevitably come to be more and more similar to one another in sound. There is a practical limit, for any species or any machine, to the number of distinct stimuli that can be discriminated, especially when the discriminations typically have to be made in noisy conditions. Suppose that Samuel F. B. Morse, in devising his telegraph code, had proposed a signal .1 second long for "A," .2 second long for "B," and so on up to 2.6 seconds for "Z." Operators would have enormous difficulty learning and using any such system. What Morse actually did was to incorporate the principle of duality of patterning. The telegraph operator has to learn to discriminate, in the first instance, only two lengths of pulse and about three lengths of pause. Each letter is coded into a different arrangement of these elementary meaningless units. The arrangements are easily kept apart because the few meaningless units are plainly distinguishable.

The analogy explains why it was advantageous for the forerunner of language, as it was becoming increasingly complex, to acquire duality of patterning. However it occurred, this was a major breakthrough; without it language could not possibly have achieved the efficiency and flexibility it has.

One of the basic principles of evolutionary theory holds that the initial survival value of any innovation is conservative in that it makes possible the maintenance of a largely traditional way of life in the face of changed circumstances. There was nothing in the make-up of the protohominoids that destined their descendants to become human. Some of them, indeed, did not. They made their way to ecological niches where food was plentiful and predators sufficiently avoidable, and where the development of primitive varieties of language and culture would have bestowed no advantage. They survive still, with various sorts of specialization, as the gibbons and the great apes.

Man's own remote ancestors, then, must have come to live in circumstances where a slightly more flexible system of communication, the incipient carrying and shaping of tools, and a slight increase in the capacity for traditional transmission made just the difference between surviving—largely, be it noted, by the good old protohominoid way of life—and dying out. There are various possibilities. If predators become more numerous and dangerous, any nonce use of a tool as a weapon, any co-operative mode of escape or attack might restore the balance. If food became scarcer, any technique for cracking harder nuts, for foraging over a wider territory, for sharing food so gathered or storing it when it was plentiful might promote survival of the band. Only after a very long period of such small adjustments to tiny changes of living conditions could the factors involved —incipient language, incipient tool-carrying and toolmaking, incipient culture—have started leading the way to a new pattern of life, of the kind called human.



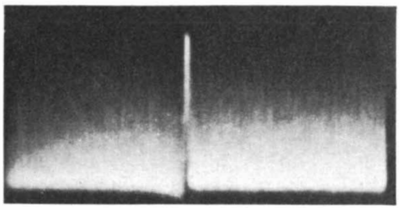
SUBHUMAN PRIMATE CALLS are represented here by sound spectrograms of the roar (*top*) and bark (*bottom*) of the howler monkey. Frequencies are shown vertically; time, horizontally. Roaring, the most prominent howler vocalization, regulates interactions and movements of groups of monkeys, and has both defensive and offensive functions. Barking has similar meanings but occurs when the monkeys are not quite so excited. Spectrograms were produced at Bell Telephone Laboratories from recordings made by Charles Southwick of the University of Southern Ohio during an expedition to Barro Colorado Island in the Canal Zone. The expedition was directed by C. R. Carpenter of Pennsylvania State University.

Kodak reports on:

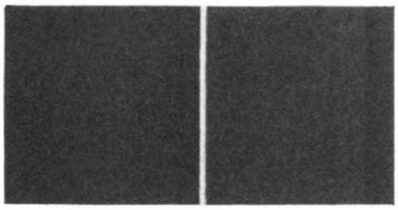
seeing the signal among the noise . . . a water-based lacquer . . . paste, beautiful paste

A human talent

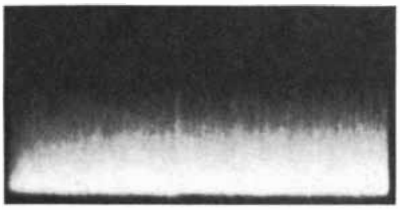
The June issue of this magazine contained an article full of learned speculation on the neurological mechanism by which lines, straight and curved, are perceived. Whatever the mechanism, the nervous system is very good at seeing a line from exceedingly faint physical stimuli. We had been thinking about ways this talent could help solve the nasty signal-to-noise problem that keeps cropping up on such occasions as when defense from submarine attack is considered. Today's almost instantly available photography makes a fine bridge from an electronic system to a human nervous system. For example:



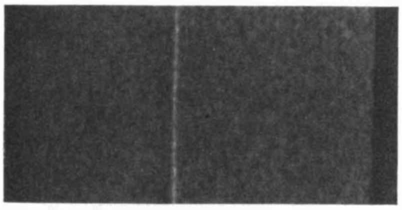
1. Instead of an ordinary A-scope trace like this . . .



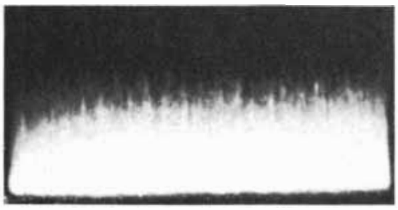
let's modulate intensity and sweep over moving film with much overlap . . .



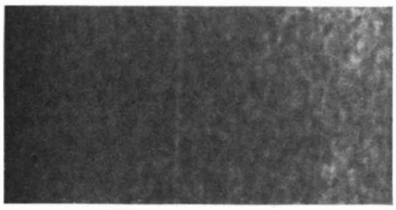
2. so that even when the significant pulse stands out from the noise no more than this . . .



photographic summing-up finds it rather easily;



3. and even when the A-scope shows only this . . .



the weak but non-random blip holds position and builds up from all the sweeps to where the marvelous combination of photography and the human perceptive mechanism says, "There!"

Organizations active in military developments who wish to know more about this work should communicate with Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y.

Creamed butyrate

In this nation of do-it-yourselfers and of housewives capable of taking the bit in their own teeth when occasion demands, do you think there would be a market for a cream that can be spread over bare wood with cheesecloth to deposit in seconds a surface chemically and physically identical to a coat of highest quality lacquer?

We have made such a cream—a stable, freeze-and-thaw-resistant water emulsion of the same kind of cellulose acetate butyrate on which the best grades of conventional lacquers are based.

The cream eliminates separate fillers, sealers and wash coats, long drying periods, excessive sanding operations, and spraying equipment. With one, two, or three coats a range of effects can be produced from a flat "natural" surface to a rich, semi-glossy, "rubbed" surface. The fast film formation permits application of successive coats within minutes and eliminates the problem of surface imperfections from dust in the air. Gentle rubbing as the film forms fills the irregularities in the wood and smooths out the top of the lacquer. Though water-based, the cream does not raise grain. After drying, the film has good resistance to water. It adheres well to the wood, seals it well, prevents penetration of subsequently applied conventional finishes (if they are desired) but holds them tenaciously.

The product itself is almost water-white, with the color stability to sunlight for which all cellulose acetate butyrate coatings have been esteemed. It neither darkens wood nor is itself darkened with the passage of time.

All these interesting properties we have demonstrated to our own satisfaction. The intricacies of marketing such a product through paint stores, supermarkets, five-and-dimes, or similarly formidable retail channels fill us with dismay. Therefore we thought we would here ask around what companies are interested in trying to make hay with this lovely development. If indeed there are any such companies, Eastman Chemical Products Inc., Kingsport, Tenn. (Subsidiary of Eastman Kodak Company) will tell them all about emulsified butyrate.

Amylose and culture

Spaghetti and macaroni are basic.

The idea of making wheat flour up into a paste and drying it for future use must have come very early. Enter esthetics. The human spirit must be nourished along with the human body. For reasons apparently unrelated to biological metabolism, the paste must be dried in certain shapes, *and the integrity of these shapes must be preserved right to the pearly portal of the alimentary tract.* This principle is ancient: the ancient Romans ate spaghetti with cheese; the ancient Japanese ate macaroni pressed from a paste of cooked rice.

When spaghetti or macaroni is cooked for too long or allowed to stand cooked, the human spirit is offended. The morsels of *pasta* revert to a sticky paste, millenia of cultural advance undone because amylose has gone into solution and then has loosely hydrogen-bonded itself into a net of slime. But for this unfortunate tendency, the world's food supply would be less dependent on specialized durum wheats. Without them, the spaghetti and macaroni would get even stickier.

The problem now appears to be as soluble as the amylose itself.

First fruits of the victory can already be tasted. Try any of the up-to-date dehydrated potato-flake brands. Compare with home-whipped potato.

Whatever the future holds for spaghetti and macaroni, the reason the instant-potato thing works out so well is that the processors add a very small percentage of pure monoglyceride. It complexes the dissolved amylose so securely that even the familiar iodine-blue test can scarcely find it.

These Myverol Distilled Monoglycerides *we prepare by glycerolysis of familiar vegetable and animal food fats. They are officially recognized as safe. Investigators who would like samples of them with which to try remedying stickiness in any starchy foods are invited to write Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company).*

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