in an air-conditioned room separate from the main rat colony. Extraneous auditory stimuli were minimized and light-darkness cycles were controlled by a time clock. After weaning at 21 days of age the animals were transferred to individual cages and were not handled again before the experimental manipulations.

The experimental treatment used a two-by-two factorial design, with thiosemicarbazide and shock stimulation as the two variables; thus there were four groups: drug–shock, drug–no shock, no drug–shock, and no drug–no shock. At 60 days of age the animals were randomly assigned to the experimental groups. The two drug groups were injected intraperitoneally with 2.0 mg of thiosemicarbazide per kilogram of body weight. Fifteen minutes later, rats in the drug-shock group received a shock session consisting of 30 shocks presented randomly during 30 minutes; each shock was of 0.6 ma for 0.75 second, delivered through the floor rods of the shocking box by a shock scrambler. Rats in the no drug–shock group underwent similar shocking. Fourteen days later all animals were subjected to immobilization stress by being taped firmly to a board for 48 hours without food or water; all were then killed and their stomachs were examined for ulcers.

It is clear from the data from experiment and replicate (Table 1) that the combination of thiosemicarbazide and shock stimulation very markedly increased resistance to stress; this effect is clearly produced by the combination and not to any extent by either treatment alone. If one considers only the number of animals in the groups showing any ulcers at all, the drug-stimulation group differed from the control groups at the 1-percent level by a chi-square test. There were no differences according to sex.

These studies support the hypothesis that stimulation at a time when concentrations of GABA and GAD are low (as in early infancy) produces prolonged increase in resistance to stress. The question of whether the phenomena observed were in fact mediated by the GABA system, however, requires more careful determination of the biochemical effects of thiosemicarbazide and much more selective manipulation of the enzyme systems concerned. The relevance of our data to the early stimulation phenomena is only inferential. The data per se are clearly of interest, however, as demonstrations of effective manipulation of the stress-resistance mechanism in the adult animal. The effectiveness of this procedure in modifying measures of emotionality other than resistance to stress-induced gastric ulceration remains to be determined.

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Zoological Classification System of a Primitive People

Abstract. *The Fore people of the New Guinea Highlands classify all animals in one of nine higher categories ("tábe aké"), and these are further subdivided into lower categories ("ámana aké"). There are 182 lower categories for vertebrates alone. The nearly one-to-one correspondence between Fore ámana aké and species as recognized by European taxonomists reflects the objective reality of the gaps separating sympatric species. In 90 percent of the cases, when a species of animal unknown to the Fore is presented for naming, it is called by the name of the Fore species considered its closest relative by zoologists. The origin of Fore classification is probably utilitarian.*

Observers have frequently remarked on the ability of primitive peoples to distinguish and to name many of the plants and animals in their environment. If one is to obtain more than a list of *nomina nuda* in a foreign language, analysis of a non-European classificatory system requires identification of the species named in order to provide an adequate basis for comparison with European scientific classification. A zoological expedition sent to the Eastern Highlands of New Guinea in 1965 to collect vertebrates and to conduct field observations for the American Museum of Natural History provided a favorable opportunity for studying the remarkably detailed classificatory systems evolved by several groups of Highland natives. This report deals with the Fore language group, whose members live near Okapa Patrol Post, 64 km southeast of Goroka, and who were brought under government control in the 1950's. They are best known for a unique degenerative disease of the central nervous system, kuru, which is still incurable, is virtually restricted to the Fore, and is responsible for up to half of their deaths (*1*). While a large part of their diet consists of cultivated vegetables (mainly sweet potatoes) supplemented occasionally by domesticated pigs, the Fore still utilize wild plants and animals extensively for food as well as for decoration and materials. Berndt (*2*) describes aspects of Fore culture. Since there is some variation in animal names from village to village, this discussion will be confined to results obtained from the inhabitants of one North Fore village, Awande (elevation, 1915 m).

Three methods were used to study Fore zoological classification. (i) Upon arrival at Awande, I asked individual Fore men to describe and name all the animals with which they were acquainted. Many of the resulting descriptions were sufficiently detailed that a zoologist acquainted with the fauna of New Guinea could recognize the identity of the species in question. (ii) After the collection of specimens had begun, individual men were brought to the collecting table and asked to name all the specimens and to provide information about habits and voice. (iii) While taking censuses of wildlife and making field observations in the jungle, I took men with me and had them name species we encountered and the bird songs we heard. In this way, descriptions of 192 kinds of animals and a list of 188 Fore names were obtained. The scientific identity of these animals was eventually determined by comparison with specimens in the American Museum of Natural History and the Harvard Museum of Comparative Zoology. While no attempt was made to obtain individual plant or invertebrate names, the list of Fore names for vertebrates should be nearly complete. With respect to birds, the group which I studied most intensively, I feel confident that there is no bird occurring regularly at Awande for which the Fore do not have a name.

The Fore classificatory system was

found to involve two levels. All animals are assigned to one of nine higher categories, designated by so-called tábe aké or "big names." Each higher category is subdivided into units which correspond in most cases to species recognized by European taxonomists, and these units are designated by so-called ámana aké or "small names." The names of the higher categories and the number of ámana aké included in each are as follows: (i) *kábara* (110 ámana aké), birds except for the cassowary; (ii) *ámanani* (one ámana aké), the cassowary, a large, flightless, ostrich-like bird; (iii) *úmu* (15 ámana aké), small flightless mammals (that is, most rodents and the smallest marsupials); (iv) *íga* (20 ámana aké), large flightless mammals (that is, most marsupials, the echidna, and giant rats); (v) *ísimi* (two ámana aké), bats; (vi) *táro* (16 ámana aké), frogs; (vii) *kwiyágine* (17 ámana aké), lizards and snakes; (viii) *úba* (one ámana aké), fish; and (ix) *kabágina* (number of ámana aké not ascertained), insects, spiders, and worms. There were no intermediate categories, such as might have corresponded to the English term "parrot" or "mouse."

As an illustration of Fore ámana aké, Table 1 compares Fore and European scientific classification of the bird families from swifts to flycatchers, following the order of Mayr's *List of New Guinea Birds* (*3*). Birds found regularly in the Fore territory are divided by the Fore into 110 ámana aké and by zoologists into 120 species. In 93 cases there is a one-to-one correspondence between a Fore ámana aké and a zoological species. In the case of four species the Fore designate male and female by separate ámana aké. All four of these species are birds of paradise or bower birds, in which the male but not the female bears plumes prized by natives for decoration; for example, the male crested gardener (*Amblyornis macgregoriae*) is called *ónkena* and the female *antáu*, while the male superb bird of paradise (*Lophorina superba*) is called *néni* and the female *piyó*. In nine instances an ámana aké is applied to two or more closely related species of birds. However, the Fore were aware of the multiple meanings of such ámana aké. For example, before collection of specimens began, Fore informants gave detailed descriptions of four kinds of birds designated as *atóku*, all of which were said to be nocturnal. Subsequent collection confirmed the accuracy of these descriptions and identified the four *atóku's* as common frogmouth (*Podargus papuensis*), marbled frogmouth (*Podargus ocellatus*), beautiful owlet nightjar (*Aegotheles insignis*), and Albertis' owlet nightjar (*Aegotheles albertisii*)—all placed in the order Caprimulgi (goatsuckers and their relatives) by ornithologists. From the ability of old men occasionally to provide separate ámana aké for each bird in such cases, I suspect that these instances of multipurpose names arise when the name for one of a group of related species passes into disuse.

To a zoologist, the ability of the Fore to distinguish between closely similar species is impressive. Two species in the notoriously confusing warbler genus *Sericornis* occur in the Fore area —the rufescent scrub-wren *Sericornis perspicillatus* and Nouhuys' scrub-wren *Sericornis nouhuysi*. Both are small drab birds about 10 cm long, which differ slightly in size (average wing-length, 5.8 cm in Nouhuys' scrub-wren and 5.3 cm in the rufescent scrub-wren) and in coloration (back browner, greater extent of orange wash on face in Nouhuys' scrub-wren). These differences are sufficiently subtle so that I was often in doubt about the identity of specimens held in the hand. Nevertheless, the Fore not only had different names for the two birds (*mabiséna* for Nouhuys' scrub-wren and *pásagékiyábi* for rufescent scrub-wren) but also could identify them correctly in the field at moderate distances without binoculars. In this case small differences in behavior and call-note had probably alerted them to the fact that more than one kind of bird was present.

Some of the names had easily recognized etymologies. For example, certain bird names, such as *to* (red bird of paradise), *kri-kro* (lilac-collared parrot), *énemesílo* (red-breasted fly-eater), and *pobogíle* (black chat-robin), were onomatopoeic descriptions of the songs of these species. A little garden mouse was called *ísawánotába*, or "sweet potato leaf," after its favorite hiding place. The black-mantled goshawk, which preys on other birds, was named *amaipána*, or "brother-killer." The name *wai*, meaning "white," was applied to the familiar white cockatoo. However, the great majority of names had no obvious etymologies and were

Table 1. Scientific, English vernacular, and Fore names for birds in the families swifts through flycatchers, following the order in Mayr's *List of New Guinea Birds* (*3*).

Scientific	English vernacular	Fore
	Swift family	
Collocalia esculenta	Glossy swiftlet	kísabe
Collocalia hirundinacea	Mountain swiftlet	ónugúteyábi
	Kingfisher family	
Clytoceyx rex	Shovel-billed kingfisher	userépo
Halcyon megarhyncha	Saw-billed kingfisher	patóroba
Halcyon sancta	Sacred kingfisher	patóroba
	Hornbill family	
Rhyticeros plicatus	New Guinea hornbill	áne
	Swallow family	
Hirundo tahitica	Pacific island swallow	kénanámitóto
	Cuckoo-shrike family	
Edolisoma montanum	Mountain cuckoo-shrike	onténti
Edolisoma caeruleogrisea	Blue-grey cuckoo-shrike	kabagége
	Pipit family	
Anthus australis	Australian pipit	iboróto
	Old-world flycatcher family	
Saxicola caprata	Black chat-robin	pobogíle
Crateroscelis nigro-rufa	Dark wren-babbler	fúntara
Crateroscelis robusta	Alpine wren-babbler	séka
Eupetes leucostictus	White-spotted scrub-thrush	iré
Malurus alboscapulatus	Black-and-white fairy-wren	asasába
Clytomyias insignis	Flat-billed wren	tabugíri
Megalurus timoriensis	Striated grass-warbler	kásaru
Cisticola exilis	Australian fantail warbler	ikonantúbe
Sericornis nouhuysi	Nouhuys' scrub-wren	mabiséna
Sericornis perspicillatus	Rufescent scrub-wren	pásagékiyábi
Gerygone cinerea	Grey fly-eater	énemesílo
Gerygone ruficollis	Red-breasted fly-eater	énemesílo
Phylloscopus trivirgatus	Island leaf warbler	pasésule
Rhipidura atra	Black fantail	tre-tre
Rhipidura albolimbata	White-eared fantail	ninikésu
Rhipidura leucophrys	Willie wagtail	kétori
Machaerirhynchus nigripectus	Black-breasted flatbill	yaragiyó
Microeca papuana	Yellow-breasted robin-flycatcher	kenantágure
Peneothello cyanus	Blue robin-flycatcher	ápari
Heteromyias albispecularis	White-striped robin-flycatcher	yobágo

said by the Fore to be simply words without meaning.

In order to obtain further insight into processes of zoological classification among the Fore, I asked men to name birds that do not occur in Fore territory and which they had never seen before. This experiment was carried out by taking seven Fore men down to Karimui, a tropical basin 160 km west of Awande at an elevation of only 1100 m, where collections of birds were being made. There is a sharp break in the distribution of New Guinea birds around 1500 m, most species being largely restricted to altitudes either above or below this elevation. Hence a majority of the birds presented to the Fore men at Karimui for naming were lowland species unfamiliar to them. The men nevertheless volunteered names of known Fore birds for these new species. Out of 103 birds so named, 91 were called by the name of the Fore species which stands closest to it in European scientific classification. For instance, 57 lowland species at Karimui do not occur in the Fore area but are classified by ornithologists in the same genera as species that do occur in the Fore area. Of these 57 species, 54 were called by the name of the congeneric Fore bird; one was named after a Fore bird in the right family but wrong genus; and two were named after a Fore bird in the wrong genus and wrong family. In many cases the Fore men were not misled by totally dissimilar color patterns and sizes, and recognized the relation between a new Karimui and a known Fore bird by underlying similarities of form and behavior, though these might be sufficiently subtle to escape many professional ornithologists. There is a group of eight small birds which various ornithologists scattered for a century among 11 different genera, until it was eventually realized that all belonged to the genus of whistlers, *Pachycephala*. The relation was deduced on the basis of similarities in song and in body shape and was obscured by differences in color (two species are yellow and black, one brown, one black and white, one spotted, one grey and white, one olive and lemon, and one rufous and olive). The Fore nevertheless called each new member of this genus that they encountered at Karimui *pítna*, the name applied to the member of the genus occurring in Fore territory. To take another example, at Karimui one of my Fore assistants collected a huge, black, short-winged, ground-dwelling bird, which neither he nor I had seen before. While I was puzzled by its affinities, the Fore man promptly proclaimed it to be a *petetóbeye*, the name for a graceful little brown cuckoo which frequents trees in Fore gardens. The new bird eventually proved to be Menbek's coucal, an aberrant member of the cuckoo family, to which some features of body form and leg and bill shape betray its affinity.

Why have the Fore developed such a detailed classification of animals? The naming of animals utilized for plumes or meat, such as birds of paradise and the larger marsupials, is only to be expected, but it seems at first inconsistent with a utilitarian interpretation that nonutilized creatures such as frogs, mice, and inconspicuous small birds are classified in equal detail. However, against a nonutilitarian interpretation (for example, that the Fore classify simply out of a love for naming natural objects) speaks the fact that there is no detailed classification of butterflies, all of which are lumped as *popoŕiya* despite species differences as striking as those among birds. Also, stars and constellations are not given individual names. Although the Fore today subsist largely on vegetables grown in their gardens, notably the sweet potato, there are several indications that the sweet potato may be a relatively recent arrival in outlying parts of the New Guinea Highlands and that a few generations ago the Fore may have depended much more heavily on wild animals and plants for food than they do now. In fact, Fore women, children, and old men still occasionally catch and eat slow game such as lizards, mice, and beetles, which adult men scorn. By this reasoning, Fore zoological classification would be an economic relict of disappearing food habits.

One might still object to an economic interpretation of Fore zoological classification by asking: Why do the Fore distinguish closely related species of small, drab, nonutilized creatures such as scrub-wrens, instead of lumping them under one name? The explanation may be that such superficially similar animals may have quite different calls and habits, which a hunter must learn to recognize in order to guide himself in his choice of prey. Suppose a hunter had learned the call of the *wárale* (King of Saxony bird of paradise, bearer of spectacular occipital plumes) and of the *kintánamu* (mountain fruit-pigeon, weighing more than 500 g, with succulent breast meat) but not of the *pásagékiyábi* (rufescent scrub-wren, drab plumage, weight 7 g). When all three were calling simultaneously, he might then have tracked down the *pásagékiyábi* in the hope of finding something new, and in the end obtained neither plumes nor meat.

Zoological classification by primitive people is of interest to biologists as an illustration of the significance of species (see *4*). Early biologists (including Darwin) were unclear about the definition of a species and sometimes regarded it as an artificial, man-made category into which animals were divided somewhat arbitrarily. Today biologists regard species as corresponding to an objective reality—namely, a group of animal populations that will interbreed with each other but not with other groups of populations. If one carefully examines the animals existing at one place today, one will find that they consist of distinct populations separated by reproductive gaps, which are associated with obvious or subtle morphological and ecological differences. Two birds may be superficially very similar and still constitute distinct species if they distinguish each other for mating purposes by songs or habits rather than by plumage. It is these reproductive gaps which the museum taxonomist seeks to deduce from the morphology of specimens and which can often be inferred much more readily from observations of living animals in the field. The classification of animals into ámana aké by the Fore, with their intimate knowledge of calls and habits, has of course an entirely different motivation from the classification of animals into species by European scientists. That the elements in these two dissimilar classificatory systems nevertheless usually show a one-to-one correspondence strikingly illustrates the objective reality of the species.

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