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Plant Classification and Nomenclature in Ndumba, Papua New Guinea Highlands¹

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Traditionally, the terms "ethnobotany" and "ethnozoology" have designated little more than the study of plant and animal utilization. In the past two decades, however, the ways in which the components of given biological environments are locally perceived and categorized have received increasing attention. Not only has the study of ethnobiological classification been recognized as essential to a wide variety of ethnographic concerns (cf. Frake 1962; Bulmer 1967), but the discovery of possible universals in folk classification systems promises to enrich our understanding of human cognitive processes as well (Berlin et al. 1973; Brown 1977).

The paucity of comprehensive studies of particular ethnobiological classification systems, however, has meant that generalizations have necessarily been based largely on a few well-described cases, most notably Hanunoo ethnobotany (Conklin 1954), Kalam ethnozoology (Bulmer 1967, 1974) and Tzeltal Maya ethnobotany (Berlin et al. 1974) and ethnozoology (Hunn 1977).

This paper provides an outline of the folk classification of plants in Ndumba, a New Guinea Highlands society. It is intended as a contribution to the ethnographic literature from a region in which ethnobotanical research has concentrated almost exclusively on plant utilization and related issues.² Aside from its possible value to regional specialists, this description allows a critical assessment of ethnobiological proposed "universals," especially those by Berlin and his colleagues (Berlin et al. 1973; Berlin 1976). Following a brief sketch of the environment and culture of Ndumba, I will describe the more formal aspects of their view of the plant world following Berlin's suggested terminology and typologies to facilitate such an assessment. It will be seen that Ndumba plant classification deviates from Berlin's proposed general principles in a few particulars that are, for the most part, probably explainable in terms of the dynamic properties of classification systems.

NDUMBA ENVIRONMENT AND CULTURE

The rugged topography of the Kratke Ranges in the extreme southeastern corner of the Eastern Highlands Province of Papua New Guinea is dominated by the Mount Piora massif, a series of jagged limestone peaks rising to 3,462

m. (11,350 ft.) above sea level. The people I refer to as Ndumba live in a cluster of six hamlets on the northern slopes of Mount Piora, claiming a territory that includes about 60 km. (24 mi.), almost 80 per cent of which is still in primary forest. From near the Piora summit, their forest stretches down to approximately 2,300 m. (7,500 ft.), the current limit of the grassland they have created and which covers the remainder of their land down to 1,600 m. (5,300 ft.). There a tributary of the Lamari River marks a social and dialectal boundary with their nearest neighbors to the north.

The streams that descend through Ndumba territory dissect a large portion of what may be called the Piora Basin, where a number of distinct speech communities meet. Ndumba themselves constitute approximately one-half of about 700 speakers of one of seven dialects of Tairora, a language in the Eastern Family of the East New Guinea Highland Stock (McKaughan 1973). Their closest neighbors to the west are the only other speakers of this dialect. Directly across the ridges to the east, and at a much lower elevation, are speakers of the Waffa language, and on the opposite slopes of Mount Piora, to the south, live Anga speakers (Baruya). Ndumba have traditionally occupied a strategic position in networks linking the Baruya salt trade (cf. Godelier 1971) with Waffa and other Tairora groups to the north (cf. Hays 1974).

The linguistic and cultural diversity of the area is paralleled by the complexity of the physical environment. In terms used for New Guinea vegetation in general (Paijmans 1976), Ndumba territory spans both the Lower Montane Zone (1,000-3,000 m.) and the Upper Montane Zone (over 3,000 m.). In Ndumba territory itself at least eight distinct vegetation communities are represented: riparian vegetation, gardens and garden regrowth, sword grass and shrub regrowth, induced grasslands, mixed-oak forest, mixed-beech forest, subalpine forest, and alpine grasslands (cf. Robbins 1970). Through their periodic visits to Waffa villages, Ndumba are also familiar with biomes found only at those lower elevations (down to 1,100 m.), but these will not be considered here.

Each vegetation community is internally more diverse than its name implies (cf. Hays 1974), and together they make up a complex botanical environment that Ndumba exploit intensively and extensively. Apart from their gardening activities they rely especially on the forest, which is rich in birds and marsupials, and which also provides abundant firewood, construction materials, wild plant foods, medicines, clothing materials, and numerous other useful products. With over 270 distinct plant uses recorded, it would be difficult to overstate the importance of plants to Ndumba. They are fortunate in being able to tap a richer biotic environment than are many Eastern Highlands peoples whose territories are largely grassland and much more limited in elevational range.

In other ways, however, Ndumba conform to a "typical Highlands" pattern, especially in their social organization and community life. Their six hamlets are spread out in a belt of habitation at around 1,920 m. All but one possess at least one men's house, around which are clustered small dwellings for the women and young children. This residential segregation architecturally manifests a widely-ramifying opposition between the sexes, as do the menstrual and childbirth houses, usually located well away from hamlets.

Ndumba engaged in chronic warfare with their neighbors until the early 1960s, and political leadership was of the nonhereditary "big man" type found

throughout the highlands. Seven or more exogamous sibs, patrilineal by ideology and in practice, form the basis for many social groupings. Nearly as important for many purposes is common residence in a hamlet, although this tends to follow descent lines as do claims on land for gardening, hunting, and collecting.

Especially important in organizing activities is a division of labor based almost completely on sex and age-grade membership. The hunting and trapping of game animals and eels, the clearing of garden land, and all construction tasks are the responsibilities of fully-initiated males, as are the tending of bananas, sugar cane, taro, and yams, and the manufacture of most implements used by men. Women are charged with the planting, weeding, harvesting, and cooking of sweet potatoes (the staple crop) and most of the 28 other kinds of food plants, the gathering of wild vegetable products from the grasslands and the forest edge, and the manufacture of items for their own use as well as the reed aprons and string bags traditionally worn and used by both sexes.

Whatever one's gender, the Ndumba individual is in almost constant contact and interaction with his botanical surroundings, from the time the neonate drops onto a cushion of *saamma* (the cultivated sedge *Eleocharis dulcis*) until he is wrapped in a shroud of *faapa* (a bark cloth, acquired from Waffa) and buried beneath a taro plant. No esoteric concern of a few specialists, knowledge of plants would seem to be a prerequisite to the very business of living in Ndumba. The richness and complexity of Ndumba plant knowledge can be seen clearly in their classification of their equally complex plant world.

NDUMBA PLANT NOMENCLATURE AND CLASSIFICATION

In fifteen months of field research, I discovered over 1,200 lexemes that were subsequently validated as plant names. I never encountered uses of these expressions as labels for anything that I would not consider to be plants, except as they were also used to name products of those plants (e.g., *sa'tari*, which may be glossed "tree or shrub" or "wood"). By the same token, nothing I considered to be plants, except for "mushrooms and most fungi" (*toza*), was ever labeled with a lexeme that could not be meaningfully inserted in elicitation frames in the same ways as could plant names. Other observational and experimental data could be adduced (cf. Hays 1974) to support the claim that, aside from its exclusion of most fungi (with the exception of some fungi, bryophytes, algae, and lichens), the domain of plants in Ndumba corresponds quite closely to what Westerners usually mean by that category.

Yet it must be admitted that Ndumba have no general term that could be glossed "plant(s)," although *mauna* (see below) is almost used in such a way. This, however, is not unusual in folk biology; the same is reported for two other New Guinea Highlands societies, the Gimi (Glick 1964) and Kalam (Bulmer 1974); and indeed it appears to be one of the general principles of ethnosystematics that the unique beginner, or most-inclusive, highest-level folk taxon, is usually not linguistically labeled (Berlin et al. 1973).

Plant Name Lexicon and Nomenclature

Through the use of formal listing requests (e.g., "Mo *kaamma* 'mo *kaammave nutu qiane*"—"Say the names of the different kinds of *kaamma*"), simple naming requests ("Nraave?"—"What is it?"), and less controlled sources of

data (e.g., requested etymologies of personal names, detailed descriptions of artifacts, translations of myths), a total inventory of over 1,400 possible plant names was accumulated. Some of these turned out to be descriptive phrases or other kinds of constructions, leaving a total lexicon of 1,247 plant names, i.e., lexical expressions that at least one of my ten informants considered to be labels for distinguishable classes of plants (cf. Hays 1974 for details on elicitation of plant names and taxonomic relationships).³

This "Composite Plant Name Lexicon" was and remains known in its entirety only by me, a fact which serves as a reminder that to say "Ndumba have 1,247 names for plants" (assuming that my sample is representative) is true only in an abstract sense. On the other hand, since there is a "Shared Plant Name Lexicon" of 970 terms—i.e., all ten informants recognize 970, or 77.8 percent of the 1,247, as legitimate plant names—we might say that the Ndumba have 970 names for plants. Yet this figure is also misleading, since it is significantly smaller than the size of any individual's actual lexicon, which range from 1,040 to 1,180 plant names known to any particular informant, with an average of 1,123.7 names (cf. Hays 1974 for preliminary analyses of this variation).⁴

Many of these plant names are synonyms, some of which are alternative plant names that have diffused from neighboring speech communities with which there is frequent interaction, including intermarriage. Some synonymy is attributable to an extensive personal name taboo system, especially involving matrilineal kin and affines; e.g., the tree called *kwaa'kesa* (*Ficus xylosyica*) may be alternatively referred to as *baaraga* by those for whom Kwaa'keso (a Ndumba man) stands in a name taboo relationship. Also, sometimes individuals bestow "private names" upon already-named plants for personal reasons, with some of these becoming more widely adopted.

Ndumba plant names, like those in other ethnobiological lexicons, may be structurally designated as either primary or secondary lexemes. Following Berlin et al. (1973), primary lexemes are "semantically unitary" (e.g., *oak*, *tulip tree*) and are either simple (linguistically unanalyzable, e.g., *oak*) or analyzable (e.g., *tulip tree*). The latter may be subdivided into those which are productive, in which case one of the constituents indicates a superordinate category (e.g., *tulip tree*, which is a kind of *tree*) or unproductive, with no constituent taken from the superordinate category (e.g., *jack-in-the-pulpit*). Secondary lexemes are those in which one constituent marks the superordinate category and all members of a contrast set are labeled in this way, e.g., *post oak*, *scrub oak*, *blue oak*, etc. (Berlin et al. 1973: 217).

Ndumba plant names employ both primary and secondary lexemes in forming monomial, binomial, and even trinomial expressions, although the last two types are usually optional in referring to particular plants. As will be seen below, in Ndumba as elsewhere, there is a generally close relationship between the linguistic structure of plant names and the folk taxonomic rank of the taxa so labeled, such that nomenclature is "often a near perfect guide to folk taxonomic structure" (Berlin et al. 1973: 216).

One final point may be added regarding the relationship between Ndumba plant nomenclature and classification. As Berlin (1976: 383) stated: "while a name may be an unambiguous indicator of a category, absence of a label does

not necessarily imply the absence of a category." In Ndumba there are at least two senses in which plant categories exist but are not named.

The first sense involves plant groupings which I have called "residual categories" (Hays 1974), i.e., groupings of all organisms that are considered to be members of some more inclusive category, but which are not given a distinctive name (for example, "It's just a tree" as a possible statement from an English-speaking informant). Such categories are usually extremely heterogeneous in membership and can occur at various taxonomic levels in Ndumba, as will be indicated below. Strictly speaking, such categories are named in Ndumba by using the name applicable to the appropriate next-higher category; thus many "trees" are "just trees" and named only *sa'tari* (distinguished for present purposes from the higher category *sa'tari* with a subscript *r*, as in Figure 2).

In the second sense, I am convinced that Ndumba recognize some groupings of plants which they give no names at all; these are what have come to be called "covert categories" or "covert taxa" (Berlin et al. 1968). There are ways to refer to such groupings in Ndumba, by employing descriptive phrases, simple lists (analogous to the covert category label "frogs and toads" in American folk zoology), or metaphors (e.g., "x and y are brothers"), but no standardized, distinctive expression is habitually used for that purpose. I have elsewhere (Hays 1976a) dealt with the difficulties in identifying covert categories in Ndumba; I would say here only that I am certain that there are many.

Plant Classification

Berlin (1973: 260) has concluded that:

One of the best documented findings of folk systematics is that prescientific man's classification of his biological universe is highly systematic and quite developed. The principles which form the basis of folk biological classification seem to be ones which arise out of the recognition of groupings of organisms formed on the basis of gross morphological similarities and differences.

The discussion to follow will be concerned with Ndumba plant classification based on morphological characteristics. This is not to say that Ndumba do not also group plants (and animals as well) on the basis of functional considerations, nor that such groupings are not generally important in folk biology. For example, the Gimi, also of the Eastern Highlands of New Guinea, recognize a category labeled *doni*, which "is roughly equivalent to 'grass,' but it also covers most weeds, a few vines, and so on . . . it means 'useless nondescript plant'" (Glick 1964: 274-275); this is parallel to a similar category Ndumba label *qaati mauna* (literally, "nothing plant"). Other such Ndumba plant categories are exemplified by *mauna fu'baa* (medicinal plants) and *waang'gusa* (weed or undesirable intrusive vegetation). The language of plants in any community probably includes such expressions, useful as they are in labeling morphologically heterogeneous groupings of organisms that share some locally significant functional characteristic. Moreover, the vegetation of the region can probably be modeled quasi-taxonomically using such categories, although such models are inevitably very shallow in depth and the membership of the categories is often overlapping, since classification is, at least in part, sensitive to particular contexts.

In descriptions and analyses it is important to keep such folk groupings separate from those that are based on morphological or behavioral characteristics. No society has yet been discovered which does not conceptualize its environment in such a way, and taxonomic models that display the mutually-exclusive groupings (folk taxa) in a hierarchical structure can be successfully constructed when sufficient data have been obtained in a systematic way.

The principles or criteria according to which Ndumba morphologically distinguish and classify plants are complex and elusive, and I will not discuss them here at length. It is worth noting, however, that the content of Ndumba plant categories cannot be understood simply as the result of grouping on the basis of characteristics shared by all members of each set. While this may be true for some categories and some characteristics (e.g., a twining stem habit), it is clear that such groupings are based more often on what psychologists call "family resemblances" (Rosch and Mervis 1975), and that Ndumba ethnosystematics provides many examples of "polythetic classification" (Needham 1975). Thus, x might be placed with y because of similar leaf shape, and y with z because the stems are thick in both, while x could not be related clearly to z on the basis of any single shared feature. This procedure for forming plant classes, which I have elsewhere (Hays 1974: 151-152) referred to as "chaining," is extremely complex to describe and analyze, as it has also proven to be for other ethnobiologists (cf. Bulmer and Tyler 1968: 357 and Hunn 1973: 115-116 for apparently similar problems in Kalam and Tzeltal ethnozoology).

The description of Ndumba plant classification presented here is derived from formal and informal eliciting, interviews, plant-naming tasks, and observations over a fifteen-month period employing my sample of ten adult informants and, to a lesser extent, scores of other Ndumba adults and children. This research focused on, and disclosed a considerable degree of, individual variation in plant knowledge, preliminary analyses of which have been presented elsewhere (Hays 1974). For present purposes, I will deal with the plant-name lexicon and a folk taxonomic model that may be considered shared by all ten of my principal informants and, by reasonable extension, imputed generally to Ndumba adults. This restriction of focus makes the description more useful for comparative studies, since published ethnobiological works overwhelmingly attend primarily to shared or composite models. Also, to facilitate a comparison of Ndumba plant classification with the general or universal principles proposed by Berlin (Berlin et al. 1973; Berlin 1976), I will employ his suggested terminology and typologies.

THE SHARED NDUMBA PLANT TAXONOMY AND GENERAL ETHNOBIOLOGICAL PRINCIPLES

As indicated in Table 1, models of my ten principal informants' individual plant taxonomies reveal a range of variation from 825 to 897 named taxa. The shared taxonomy is somewhat smaller than any of these, including only 766 named plant classes; i.e., all ten informants agree as to the existence and class membership of 766 mutually-exclusive and hierarchically-ordered named groupings of plants. With the addition of the unnamed unique beginner ("plants"), the taxonomy contains 767 taxa. This shared taxonomy could be generally characterized by saying that, like other described folk taxonomies, it is relatively shallow when compared to scientific taxonomies, encompassing the entire

TABLE 1
Distribution of Named Plant Taxa by Taxonomic Rank

Informant*	Life Form	Generic	Specific	Varietal	Sub-variatal	Total
A	5	430	372	26	2	835
B	5	454	398	26	2	885
C	5	445	401	30	2	883
D	5	434	404	28	2	873
E	5	448	400	29	2	884
F	5	405	389	24	2	825
G	5	418	397	26	2	848
H	5	422	395	27	2	851
I	5	428	397	26	2	858
J	5	445	412	33	2	897
Mean	5	432.9	396.5	27.5	2	863.9
Range	5	405-454	372-412	24-33	2	825-897
"Shared"	5	385	350	24	2	766
"Composite"	5	Indet.	Indet.	Indet.	2	Indet.

*Informants A-E are males, F-J females, in order of ascending age.

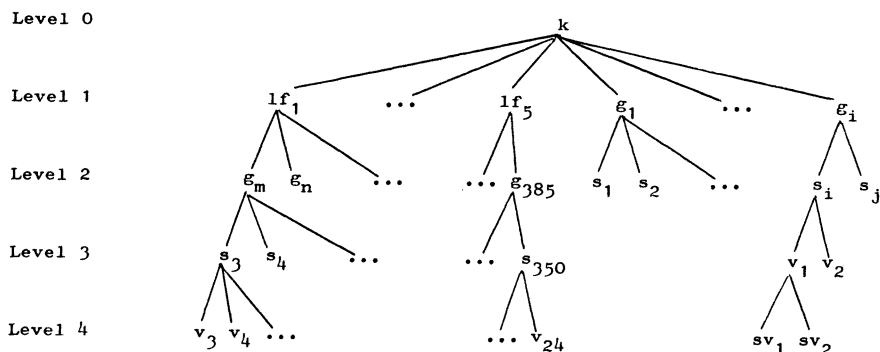
Ndumba plant world in only four hierarchical levels of named taxa, with the unnamed unique beginner solely occupying a fifth.

Folk taxa, like scientific taxa, are of several distinguishable types, which Berlin (1976: 381) has called "ranks" and which can be defined and distinguished on the basis of a combination of linguistic, biological, taxonomic, and psychological criteria. In this description I will follow Berlin and refer to taxa as being of kingdom, life form, generic, specific, varietal, or sub-variatal rank.⁵ The distribution of these ranks across hierarchical levels is indicated in schematic form in Figure 1.

As already discussed above, the sole Ndumba taxon occurring at Level O, and which is assigned the rank of kingdom, is the covert (unnamed) taxon I have referred to as "plants." The numerical distribution of named taxa across the various other ranks is shown in Table 1, which also includes data on individual variation in folk taxonomy size. A complete display of the shared folk taxonomy in detail may be found in Hays (1974).

Ndumba Taxa of Life Form Rank

Folk taxa of the life-form rank are the most-inclusive, wide-ranging named categories, with the following additional characteristics (Berlin 1976): they occur at Level 1, immediately preceded by the unique beginner of kingdom rank; they are few in absolute number; they are invariably polytypic; they include the majority of all other taxa; they are labeled with primary lexemes;

FIGURE 1: Schematic Relationship of Ndumba Ethnobotanical Ranks and Their Relative Hierarchical Levels (adapted from Berlin et al. 1973: 215)

they are biologically diverse in content; and they are psychologically defined by a small number of biological characters, most of which in folk botany refer to stem habit.

In the shared Ndumba plant taxonomy there are five Level 1 taxa, out of a total of 33 taxa that occur at that level, which exhibit all of these characteristics: they are all polytypic; among them they include 552 out of 761 taxa of lesser rank (73 per cent); they are all labeled by unanalyzable primary lexemes; they are all extremely diverse in biological range; and each can be defined by a small number of morphological characters. These taxa and glosses of their respective names are: *foringa*—mosses, lichens, and some fungi; *mauna*—herbaceous plants and some ferns; *muso*—grasses, sedges, and rushes; *sana*—vines and lianas (herbaceous or woody); *sa'tari*—trees, shrubs, and tree ferns.

All of these plant names are polysemous in various ways. Each life-form taxon includes a residual category that is labeled with the name of the life form. Also, one (*muso*) includes a type generic taxon, which may be referred to simply as *muso* or, to avoid any ambiguity, *muso tuana'nraanra* ("genuine *muso*" or "true *muso*"). In addition, any of the names excepting *foringa* may be applied to products of appropriate plants, e.g., leaf decorations, thatching material, lashing material, or wood.

The most polysemous of the five terms are *mauna* and *sa'tari*. Either term may be used as an attributive in conjunction with other life-form names. For example, strong, woody lianas or vines may be called *sana*, or by their more precise folk generic or folk specific names, or *sa'tari sana*, in which case *sa'tari* may be seen as an attributive meaning "woody." On the other hand, there are no "woody mosses" or "woody grasses" except for stiff cane grasses that, I was told, are easily broken and the expression *sa'tari muso* makes no sense.

The use of *mauna* as an attributive is more extensive and complex, with the constructions *mauna foringa*, *mauna muso*, *mauna sana*, and *mauna sa'tari* all possible. If any part of a shrub, tree, vine, grass, or moss is useful, e.g., for medicine or body decorations, the plant could be designated with *mauna* plus its life-form name. Thus *mauna* may be considered in some contexts an attributive meaning "useful." The construction *mauna mauna*, however, is not acceptable although there are "useful *mauna*" in contrast to *qaati mauna* ("nothing

mauna')). With regard to the attributive *qaati*, *qaati foringa*, *qaati muso*, *qaati sana*, and *qaati sa'tari* are considered odd but allowable expressions. This further supports the interpretation that *mauna*, when juxtaposed with a life-form name, is being used as an attributive, rather than an indication of ambiguous life form membership (cf. Berlin 1976: 387 for "ambiguously affiliated folk generics").

A further polysemous use of *mauna*, as earlier mentioned, is that in some contexts *mauna* is used as a general term for "plants." Thus, sometimes in setting out on plant collecting trips, my field assistants would respond to their neighbors' queries with, "we're going to collect *mauna*." Also, in discussing my work in general, Ndumba would refer to it as having to do with *mauna*. Direct inquiries as to whether all plants could be referred to as *mauna*, however, always evoked negative answers or suggestions that confusion could well result.⁶

Ndumba Taxa of Generic Rank

In addition to the five life-form taxa, 28 other named categories occur at Level 1 of the folk taxonomy. Since they share a number of characteristics with the 357 taxa that are immediately included (at Level 2) in the five life-form taxa, all 385 categories will be considered Ndumba folk generic taxa.

According to Berlin et al. (1973: 216), folk generics are the "basic building blocks of all folk taxonomies," being the most commonly referred-to groupings, those that are psychologically the most salient and are likely to be among the first taxa learned in childhood. Folk generic taxa "mark the smallest classes of plants and animals that do not require much close study to recognize" (Berlin 1976: 389), and may be identified by the analyst in terms of a number of criteria: they are consistently labeled, usually with primary lexemes; most are taxonomically included in the life-form taxa, but some are unaffiliated or ambiguously affiliated; most are monotypic; and when polytypic, most are bitypic.

The 385 Ndumba taxa in question are all consistently named with primary lexemes. Most Ndumba folk generic names are unanalyzable (simple) as normally used, but it is allowable to binomialize most of them by adding the life-form name that is appropriate. For example, *so'mi* labels a folk generic (*Trachymene adenodes*) within the life form *mauna*; one could refer to it as *so'mi mauna*, but this is regarded by informants as odd, useful only to preclude any possible ambiguity.

Many folk generic names are analyzable, but only nine are productive, seven of which are included in the life form *sana* (vines and lianas), e.g., *nrausa'sana* ("house *sana*" which is used for lashing in house construction). More numerous are unproductive analyzable generic names, e.g., a *mauna* called *quara'saato* (pig's ear), or a *muso* generic *hora'vaira* ("man flower," i.e., a flowery plant, usually a weed, which exists only due to man's activities).

The vast majority of Ndumba generics are included in the five life-form taxa and thus occur at Level 2 in the taxonomic structure: 8 in *foringa*, 68 in *mauna*, 37 in *muso*, 46 in *sana*, and 198 in *sa'tari*, for a total of 357 of the 385 total generics (93 per cent).⁷ Within any life form the folk generics are contrasted in terms of numerous characters, which for any particular pair of generics might include leaf size, shape, and texture (but seldom leaf color), stem or trunk

thickness, and fruit size, shape, and color, as well as many others. Each life form taxon also includes a residual generic category which itself might be a heterogeneous grouping.

The remaining 28 generics are unaffiliated, occurring at Level 1 of the taxonomic structure. These are all labeled with primary lexemes (probably all unanalyzable). According to Berlin et al. (1973: 216), unaffiliated generics are not assigned to life-form taxa because they manifest some kind of aberrancy, which "may be due to a number of factors but morphological conspicuousness and/or economic importance appear to be the primary reasons involved." Of the 28 Ndumba unaffiliated generics, all but two are cultivated food plants (and "tobacco"). Those two are morphologically conspicuous indeed: *faasa'tiri*, a fleshy parasite (*Mitrastemon yamamotoi*) found emerging above ground level from the roots of "oak" trees, and *muwaake'rira*, a spiny epiphytic shrub (?*Myrmecodia* sp.) whose swollen stems contain chambers occupied by ants.

I do not believe there are any Ndumba folk generics that are ambiguously affiliated with two or more life forms, although my interpretations of designations such as *mauna muso* (see above) may be mistaken and actually represent ambiguous generics.

In accordance with Berlin's generalization, most (333, or 86.5 per cent) Ndumba generics are monotypic, leaving 52 (13.5 per cent) which are not terminal taxa but polytypic. Of these 52, however, only 10 (19.2 per cent) are biotypic, as opposed to Berlin's expectation that most would be.

Ndumba Folk Specific Taxa

To this point Ndumba plant taxonomy has conformed very well to the generalizations of Berlin and his colleagues. When subgeneric taxa are considered, however, a number of points of divergence arise.

Folk specific taxa are said to occur characteristically in contrast sets of two or three members, the most frequent being a set of two classes and rarely exceeding six (Berlin 1976): "Contrast sets of more than two members tend to refer to organisms of major cultural importance and larger sets of twenty or more taxa invariably do" (Berlin et al. 1973: 216). Folk specifics "differ on the basis of very few morphological characters; frequently these are readily visible and sometimes verbalizable" (Berlin 1976: 390). Finally, these taxa are most commonly labeled with secondary lexemes, with the exception of monomial type specifics, the foci of generic categories, which are labeled with the generic names and singled out due to their cultural importance, widespread distribution, or morphological prominence (Berlin 1976). Aside from type specifics, monomially-designated specifics "will invariably refer to [taxa] of major cultural importance" (Berlin 1976: 392).

The 350 Ndumba folk specifics occur on Levels 2 and 3 of the taxonomic structure, and all are included in the 52 polytypic folk generics. As expected from Berlin's characterization, members of any particular contrast set are distinguished on the basis of very few morphological characters. For example, the eight folk specifics of the generic *faa'nresa* (various *Zingiberaceae*) are apparently distinguished simply on the basis of leaf size and stem length; the two subdivisions of *kem'bora* (both are *Ficus dammaropsis*) differ only in fruit color; and the 23 *kaamma* (*Ipomoea batatas*, sweet potato) specifics are con-

trasted primarily by leaf shape and size, with the inside color of the tuber important in a few cases.

Berlin's generalizations do not fit the data well, however, with respect to the size of contrast sets of specifics or regarding the linguistic structure of Ndumba specifics' names.

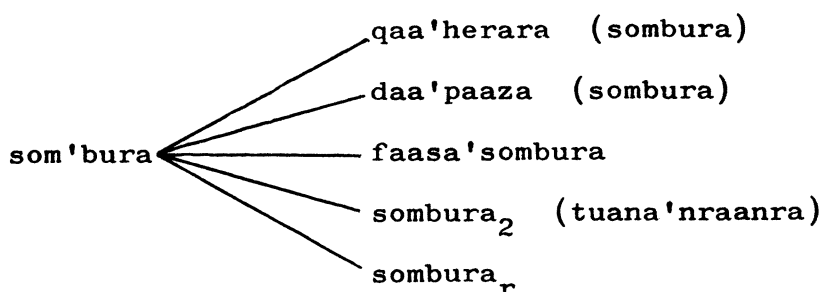
The 52 contrast sets of folk specifics vary widely in size, ranging from two members (nine) to 23 (one). This is an unusually high degree of polytypy for folk generics; i.e., Ndumba distinguish a larger number of specifics, and group them into larger sets, than has been found in other folk classification systems. While Berlin would expect most contrast sets of specifics to be two- or three-membered, in fact only seventeen (or 32.7 per cent) are.

According to Berlin et al. (1973: 216), those sets of folk specifics which contain more than two members "tend to refer to organisms of major cultural importance and larger sets of twenty or more taxa invariably do." I have elsewhere (Hays 1976b) discussed various problems in analytically and operationally defining and measuring cultural importance. For present purposes I will consider a folk taxon to refer to plants of "high" importance if they are food plants or are used in ways for which there are few if any substitutes (e.g., *feva*, or black palm, which is used for bows, ax handles, and arrows). By these criteria 35 of the 43 (81.4 per cent) of the folk specific sets with more than two members include plants of "high" or "medium" cultural importance, while 31 of the 35 (88.6 per cent) sets with more than three members do. The three largest sets, with 19, 22, and 23 members, include the three principal Ndumba root crops: yams, taro, and sweet potatoes, respectively. Thus it appears that in this regard Berlin's generalization is supported by the Ndumba data, although the degree of elaboration at the folk specific rank was not anticipated.⁸

More serious problems are posed with respect to the linguistic structure of Ndumba folk specific names. As earlier noted, Berlin has found that, with the exception of type specifics, subgeneric taxa are labeled with secondary lexemes; i.e., all members of a contrast set of folk specifics (or varieties) have names one constituent of which marks the superordinate folk generic. An example from Ndumba folk botany, which illustrates this usual pattern but also suggests some problems, is the contrast set of specifics included in the folk generic *som'bura* (*Impatiens* spp.), which is included in the life form *mauna*.

As can be seen in Figure 2, in the shared folk taxonomy *som'bura* contains five folk specifics, one of which, *faasa'sombura*, clearly derives one of its two constituents from the name of the superordinate generic. At first glance, *faasa'sombura* appears to be the only *som'bura* specific that is so marked. However, two of the other specific names may be binomialized, although they usually are not; thus one could say *qaa'herara 'sombura* and *daa'paaza 'sombura*. Moreover, the type specific, which I have identified with a subscript 2, can be reformulated, since for precise reference one would refer to it as *sombura tuana'nraanra*, "genuine" or "true" *som'bura*. Thus it becomes a binomial, marked with the name of the superordinate category, as do the type specifics that are included in 42 of the 52 polytypic generics.

The folk specifics included in *som'bura*, then, would be considered as labeled with secondary lexemes were it not for *sombura*, the residual specific category that includes all plants that are *som'bura* but which are not assignable to any of

FIGURE 2: The Ndumba Folk Generic Taxon *som'bura* and its Included Folk Specific Taxa

the *som'bura* specifics. Of the 52 sets of folk specifics, fifteen sets include residual specifics that may not be binomialized. Strictly speaking, then, many Ndumba folk specifics could be said to be labeled not with secondary lexemes but, excepting the residuals themselves, with productive primary lexemes.

Additional problems are created by what appear on present evidence to be some obligatorily-monomial folk specifics. At least seven of these exist, according to two informants who were intensively questioned on the matter. I was unable to elicit any explanation for the fact that, unlike the vast majority of folk specific names, these seven could not be binomialized. According to Berlin (1976), such monomially-designated specifics should refer to taxa of major cultural importance. However, five of these seven are not taxa of great significance and are, in any case, less important than are other specifics within the same generics but which may be binomialized.

Two of the seven are of major cultural importance (and both are further subdivided into folk varietals). The first is *hanra*, a specific (with two folk varieties) within the generic *saivu* (various *Pandanus* spp., both cultivated and wild). The fruits of *hanra* are highly valued for their oily juice, as are the fruits of some other *saivu*. The second is *nraa'mmunra* (?*Amaranthus* sp.), a polytypic folk specific with five folk varieties within the unaffiliated generic *kaa'pisi*.

Doubtlessly relevant to this latter case is the fact that *kaa'pisi* is a recently created folk generic category that contains, in addition to *nraa'mmunra*, various leafy green vegetables (mostly lettuces and cabbages, from the latter of which the category takes its name) introduced to Ndumba by Europeans and through native trade networks within the past twenty years. I propose that *nraa'mmunra*, as an indigenous, or at least pre-contact, category of edible leafy greens, previously was a folk generic that was subsequently absorbed by the named category *kaa'pisi*. The refusal to binomialize the name *nraa'mmunra* may reflect some ambivalence about this taxonomic demotion of a highly valued food plant.

Strictly adhering to the criteria for secondary lexemes, if any member of a polytypic generic is not marked with the generic name, none of the members' names qualify as secondary lexemes. This would mean that 127 out of the 350 Ndumba folk specifics are labeled with primary lexemes. Such a challenge to Berlin's generalization regarding subgeneric taxa names, however, should not be allowed to obscure the nature and significance of binomialization as a commonly occurring pattern of folk nomenclature.

Ndumba Folk Varietal and Sub-variatal Taxa

Seven, or 2 per cent, of the 350 Ndumba folk specific taxa are polytypic, and the 24 taxa they include may be assigned the folk varietal rank. They occur on Levels 3 and 4 of the taxonomic structure. Berlin has found folk varietals to be rare in the systems so far described (Berlin et al. 1973; Berlin 1976). Where they do occur, they have the same characteristics as do folk specific taxa, viz., they occur in few-membered sets, they are distinguished on the basis of very few characters, and they are labeled with secondary lexemes.

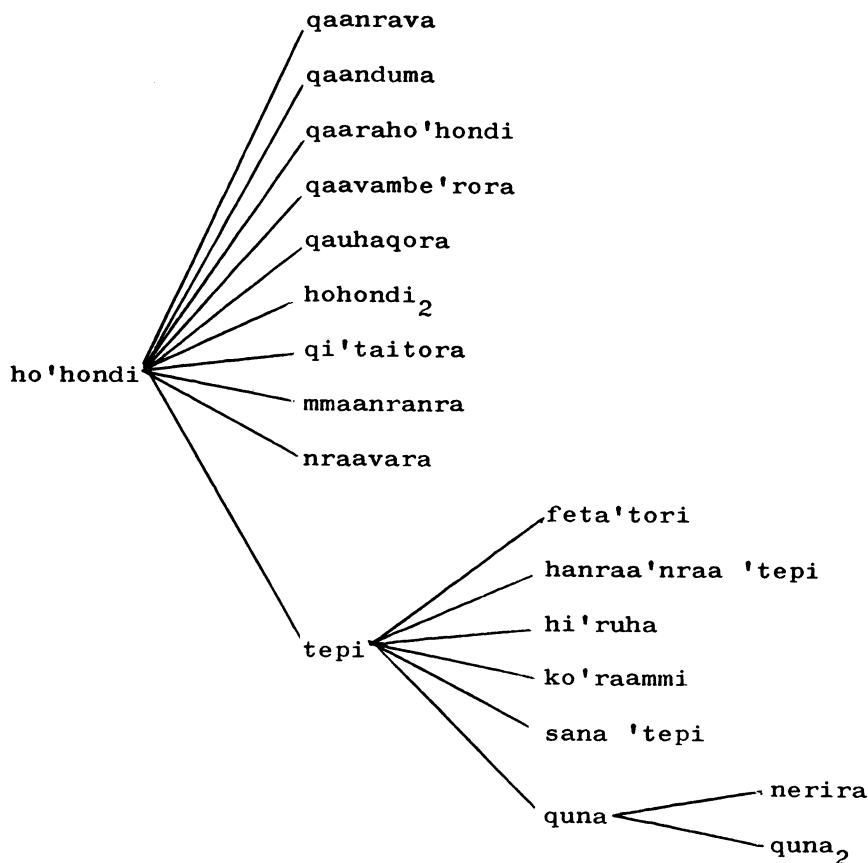
Ndumba folk varietal taxa present no deviations from this general pattern. The seven sets of varietals include two of two members each, three three-membered sets, and one each of five and six members. Both of the last two are food plants: *nraa'mmunra*, already discussed above, and *tepi*, the "winged bean" (*Psophocarpus tetragonolobus*), about which more will be said below. A third set of varietals that are cultivated is *hanra*, also already discussed. A fourth is *kaapi*, which includes important medicinal and ritual plants (*Curcuma* spp.). The remaining three sets are all types of cane grasses, subdivisions of the specifics *kung'gura*, *taura*, and *qunro* in the generic *bosa* of the life-form *muso*. These canes are variably useful and at least two of the varietals are cultivated. With respect to cultural importance, then, Ndumba folk varietals vary widely, ranging from extremely important to not so at all.

Varietals are usually distinguished in Ndumba on the basis of one or two characters; e.g., the two *taura* types are contrasted simply by the presence or absence of "hairs" on the stems and leaves. The names given to Ndumba varietals present no problems such as those discussed above for specifics. Four of the seven sets, unlike the three food plant sets *hanra*, *nraa'mmunra*, and *tepi*, have type varietals but none of them includes residual varietals. All varietal names may be binomialized, although they usually are not. Only two sets of varietals, on the other hand, may be trinomialized, e.g., *kwaam'bimba kaapi henggunru*, or *konga 'kunggura bosa*. All Ndumba varietal taxa may thus be said to be labeled with secondary lexemes.

Perhaps unique among ethnobiological classification systems so far described, the Ndumba folk taxonomy includes two taxa of the folk sub-variatal rank, occurring only at Level 4 of the taxonomic structure. They are subdivisions of *quna*, a varietal within the specific *tepi*, which is included in the unaffiliated generic *bo'hondi* (Figure 3).

Subdivision to this fine a degree is unusual for Ndumba, with *quna* as the only instance in individual informants' taxonomies as well as the shared model here discussed. Ndumba consider *nerira* to be a wild, poisonous form of the cultivated, edible bean *quna tuana'nraanra*, or "genuine" *quna*. In fact, according to my plant collections, *quna*₂ is *Lablab purpureus* (*Dolichos lablab*), while *nerira* refers to *Phaseolus lunatus*. The two subvarietals are also distinguished by leaf and bean size; since *nerira* is considered to be poisonous, it is an important distinction to make.

This unusual case of taxonomic elaboration is possibly explainable in terms of recent historical changes in Ndumba plant classification, as was *nraa'mmunra* above. The term *tepi* labels a category that includes *quna*, but whose focus is clearly the "winged bean," *Psophocarpus tetragonolobus*. An important food

FIGURE 3: The Ndumba Folk Generic Taxon ho'hondi and its Subdivisions Including Subvarietal taxa

plant of great antiquity in the New Guinea Highlands, the "winged bean" was probably the only type of bean cultivated by Ndumba until the last two decades, with the possible exception of "genuine" *quna*, *Lablab purpureus*. I would hypothesize that, prior to European contact, *tepi*, which may or may not have included *quna* at the time, was an unaffiliated generic taxon, as are so many other food plants. If *quna* was included, it would have been a folk specific with two varietal subdivisions. With the arrival of numerous European beans, particularly in the 1960s, a resemblance to *tepi* (in bean but not in pod form) must have been perceived and a new category created, taking its name, *ho'hondi*, from the collective name for the various new beans, most of which were *Phaseolus* spp. With the absorption of *tepi* into this new category, *tepi* and *quna* would have shifted down one rank taxonomically, with the resulting unusual situation at present.

CONCLUSIONS

The formal aspects of the shared Ndumba folk taxonomy of plants have now been described in some detail. Since it is the first New Guinea Highlands plant classification system to receive such attention, it has not been possible to compare Ndumba plant ethnosystematics to that of similar societies in New

TABLE 2
Comparison of Ndumba Plant Classification with Proposed General Principles

Taxonomic Rank	Expectations	Ndumba
Kingdom	1 (covert)	1 (covert)
Life Form	Few (5-10) Level 1 Polytypic Few Distinguishing Characters Primary Lexemes	5 Level 1 Polytypic Few Distinguishing Characters Primary Lexemes
Generic	500-600 Levels 1 and 2 Most Monotypic Many Distinguishing Characters Primary Lexemes	385 Levels 1 and 2 86.5% Monotypic Many Distinguishing Characters Primary Lexemes
Specific	Fewer than Generics Levels 2 and 3 * Usually 2- or 3-membered Sets Few Distinguishing Characters * Secondary Lexemes	350 Levels 2 and 3 32.7% 2- or 3-membered Sets Few Distinguishing Characters Primary Lexemes (?)
Varietal	* Rare Levels 3 and 4 Few-membered Sets Few Distinguishing Characters Secondary Lexemes	24 Levels 3 and 4 5 of 7 Sets Have 2 or 3 Members Few Distinguishing Characters Secondary Lexemes
Sub-variatal	* - - - -	2 Level 4 Few Distinguishing Characters Secondary Lexemes

* Clear point of difference.

(Berlin et al. 1973; Berlin 1976)

Guinea except at a few points. However, it does conform very well, for the most part, to the general principles of classification and nomenclature proposed by Berlin and his associates for mankind as a whole, as can be seen in the summary in Table 2. Moreover, the points of divergence are restricted to the sub-generic taxa and seem at least partly reconcilable with those general principles. Some critics, especially Bulmer (1974), have suggested that Berlin's typology and generalizations in their earlier formulation (Berlin et al. 1973) were premature, based as they necessarily were on a small number of well described systems, and possibly unduly informed by the Tzeltal case, with which Berlin was most familiar. With regard to these charges, it is significant to note that Berlin (1976) subsequently modified some of the earlier proposals as a result of his research in a second society, the Aguaruna Jivaro, and the description of additional systems such as Ndumba (in Hays 1974). The analysis offered here may indicate the need for additional modifications, particularly with respect to the relationship between classification and nomenclature.

The Ndumba data support Berlin's generalizations for the life-form and generic ranks, but differences occur below that level of abstraction. Ndumba folk specific taxa show a much higher degree of polytypy than anticipated by Berlin, and the relationship to cultural importance, however that may reasonably be measured, is not so clear as he has argued. Also, it appears that the earlier claims that folk specific taxa would be labeled with secondary lexemes is in need of revision. In Ndumba, binomialization is rarely obligatory, usually allowed, but in some cases emphatically prohibited. This, together with the existence of residual categories, suggests that nomenclature is not as perfectly associated with taxonomic structure as has been maintained.

While varietal taxa are not numerous in Ndumba when compared with the other taxonomic ranks, they apparently are much more so than in other folk classification systems. Also, Berlin has not so far discussed subvarietal taxa, which are present although extremely uncommon in Ndumba. It is important to note that the exceptions to Berlin's proposals which concern varietal and subvarietal taxa may be largely explained in terms of historical changes in Ndumba plant classification, as in the cases briefly discussed in this paper. While this qualifies any claim that Berlin's generalizations do not fit the Ndumba case, it draws our attention to the necessity of appreciating, and documenting whenever possible, the diachronic aspects of folk classification, as Berlin has himself appreciated (Berlin 1972; cf. Brown 1977).

One of the most interesting remaining questions is why Ndumba and other peoples pay such close attention to their environment in the first place. It is clear that their interest in flora and fauna is not motivated simply by utilitarian considerations (Hays 1976b; cf. Bulmer and Tyler 1968). Final answers will doubtless only come with analyses that go beyond the formal and structural aspects of varying conceptualizations of nature and see these in the context of total cultures, and with an improved understanding of the workings of the human mind.

NOTES

1. I am grateful to Cecil Brown, Allan Burns, Harold Conklin, Per Hage, and Eugene Hunn for many helpful comments on an earlier draft of this paper, and to Brent Berlin, James Watson, and, especially, Patricia Hurley Hays for their encouragement over the years. The

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2. With the exception of Bulmer's extensive and excellent publications on Kalam ethnozoology (see references), New Guinea Highlands ethnobiology has been reported only in fragments or extremely restricted descriptions (cf. Bulmer 1974 for a survey discussion). This is especially true for ethnobotany (e.g., Glick 1964; Strathern 1969), although a substantial body of information on Highlands plant uses is available (cf. Powell 1976 for a valuable compilation).

3. My principal informants in Ndumba were ten adults, five men and five women, roughly matched for age (ranging from early twenties to late seventies) and marital status.

4. Some of the figures reported here are based on recent analyses of field data and supersede those given in Hays (1974).

5. An additional rank proposed by Berlin, intermediate, is excluded from this discussion since, except for the unique beginner, I am dealing here only with named taxa.

6. Cecil Brown (personal communication) has suggested that *mauna* may have originally designated any useful plant, later expanded in its range to include all small plants, and finally, with the emergence of *muso* as a label for grasses, contracted to its current primary meaning. This might account for the high degree of polysemy of *mauna*.

7. It is of interest to note that in their partial reports on other New Guinea Highlands plant classification systems Bulmer reports that Kalam subdivide the taxon *mon* (tree) into about 200 categories (Bulmer 1974), and Glick (1964) attributes at least 200 members to the Gimi category *da* (tree). In addition, Bulmer (1974) reports about 40-50 members of the Kalam taxon *mn* (vines).

8. In an analysis too complex for adequate discussion here, Geoghegan (1976: 478) has suggested that such a distribution would be expected "where biological diversification is comparatively recent." By this he does not mean that the Ndumba flora itself has only recently evolved, but that Ndumba may have only recently begun to make low-level distinctions among plants, as would be the case if horticulture, which produces wide variation within folk generics through cultivation, were relatively recent. Whether or not Ndumba only began intensive horticulture with the arrival of sweet potatoes a few hundred years ago or even earlier, there is little question that they are relative newcomers to plant domestication when compared with the other societies whose ethnosystematics have been described. Thus it may be that Ndumba deviate in this respect from general patterns because they represent an early stage of taxonomic development. The validity of this line of argument, however, depends on the nature of these polytypic folk generics, especially with regard to the cultural importance or significance of the folk specifics that are distinguished.

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