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Ikhtisar

Penulis karangan ini, Pendeta Gordon P. Larson, telah puluhan tahun bekerja di pedalaman Irian Jaya sebagai misionaris dan juga ahli bahasa.

Kertas ini membicarakan talaah yang dilakukan dengan metoda leksikostatistik, dengan maksud untuk menunjukkan adanya hubungan asal dua keluarga bahasa di daerah pedalaman Irian Jaya dan juga hubungan yang terdapat pada bahasa-bahasa lain yang lebih kecil humlah penutur aslinya.

Dengan mempergunakan karya-karya orang lain sebagai bahan perbandingan, kertas ini merupakan islah satu karya yang paling terperinci mengenai bahasa-bahasa di daerah pergunaan tengah Irian Jaya. (Ed. I.S.)

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1. Introduction

My work as a missionary linguist and Bible translator has
TABLE 1

Dialects Compared

(Listing is in same order as their west-to-east geographical distribution)

EKOMO (or WISSEL LAKES-KEMANDOGA) FAMILY:
1. Ekagi (or Kapauk), Paniai dialect (Ek)
2. Wodani, Nbiyandoga dialect (Wo)
3. Moni, Kemandoga dialect (Mo-K), but where differences with Dugindoga dialect (Mo-D)

DAMAL (or UHUNDUN, or AMUNGME) LANGUAGE ISOLATE:
4. Damal, Atowa dialect south of Range in Puncak area (Dam-A)
5. Damal, Itagga dialect north of Range in Puncak area (Dam-I)

DEM LANGUAGE ISOLATE
6. Dem, Pina dialect of lower Jajo (Dem)

GREATER DANI FAMILY

WANO SUBFAMILY
7. Wano, Turumo dialect (Wan-T)
8. Wano, Lower Jajo dialect (Wan-J)

CENTRAL DANI SUBFAMILY
9. Western Dani, Pit River dialect of North Baliem (WD-Pit)
10. Western Dani, Upper Pyramid of Grand Valley (WD-UpPy)
11. Wodo and Pyramid of Upper Grand Valley (Py-Wodo)
12. Mid Grand Valley (MV)
13. Hitigima of Lower Grand Valley (Hit)
14. Tangma of Lower Grand Valley (Tang)

NGALIK-NDOGA SUBFAMILY
15. Kirilaeima of Amo Valley east of Grand Valley (Kin)
16. Yellimo of Anggaruk (Angg)
17. Nduga of Shik Valley, but recent immigrants from south of Range (Ndug)

involved me deeply in the study and analysis of two languages of the two largest families of languages in the interior of Irian Jaya: Moni of the Ekagi-Wodani-Moni (or Wissel Lakes - Kemandoga) family (from 1953-56), and Western Dani of the Greater Dani family (from 1956-76). Both phonological and lexicostatistical studies have been made on each. My purpose here is not to restate, except by way of summary, what has already been written concerning the linguistic relationships between languages within these families. Rather, it is to make a lexicostatistical statement demonstrating the genealogical links between not only these two families, but also between these and two other smaller but important distinct family-level language isolates: Damal and Dem. Representative languages from all four families of the area from as far west as the Wissel Lakes to as far east as Anggaruk will be included in the study (see map, Appendix B). They are given in Table 1.

1.1 Ekagi-Wodani-Moni (hereafter called EKOMO)

Ekagi is by far the largest language grouping of the EKOMO family with from 60,000 to 100,000 speakers. Moni is next with about 15,000; Wodani the least with some 3,000. The Ekagi occupy areas surrounding and out from the Wissel Lakes from as far southwest as Mapia to as far northeast as the lower Kemandoga. Here Ekagi speakers live in close proximity with both Wodani and Moni groups. Moni population is found mostly east from this point up into the mid and upper Kemandoga and northeast into the Dugindoga. The Wodani are mainly in the Nbiyandoga immediately north of the lower Kemandoga.

In our lexicostatistical study of EKOMO (see Larson and Larson, 1972), my wife and I used Swadesh's 100 word list (Swadesh, 1955) as a basis for comparing the lexical retention rates between Ekagi, Wodani, and Moni. Our study resulted in the
following generalized average percentages of cognition between the language pairs:

- Ekagi - Wodani: 51.5%
- Wodani - Moni: 40.2%
- Ekagi - Moni: 28.1%

We also followed Swadesh's criteria for classification: separate languages if each of a pair shares less than 81% of its core vocabulary; same family if from 28-80; same stock if from 12-27; same microphyllum if from 4-11. All dialects of EkWoMo, it was concluded, are members of a single family, though we were hesitant about including Moni without qualification, since it also shares a relatively large vocabulary with Central Dani: from 21.7% to 29.4% according to this study as can be seen in the next section.

1.2 Greater Dani

Greater Dani, according to Bromley (1967), is composed of three subfamilies: Central Dani, Ngalik-Nduga, and Wano. The main Central Dani dialects are those given in Table 1. They are concentrated in the Grand Valley, but fan out west and north west to as far as most valleys of the upper Rouffaer. Western Dani is the largest Central Dani language with about 100,000 speakers occupying most valleys running in two almost straight lines, one from Pyramid west to Ilaga, and the other from Bokondini (Mbogondi) west to the Mid-Dugindoga. The rest of Central Dani population is concentrated in the Grand Valley and lower Balien and approximates Western Dani in size. Areas occupied by speakers of Ngalik-Nduga form a kind of horseshoe cupping the Grand Valley from the east, with Nduga to the south running west, and Ngalik to the southeast, east, and north. There are sizeable pockets of Nduga also in Sinak and Dugindoga.

The Wano, though dispersed over a rather large area, are the least in number of all members of the Greater Dani family. They occupy areas on the north side of the Jamo of the upper Rouffaer, and are also found in scattered pockets to as far north of Jamo as where the foothills join the Lakes Plaines, and west of Jamo on into the lower Dugindoga. They number about 3,000.

Data on Greater Dani, except on Western Dani, Wano, and Nduga, are taken from Bromley's lexicostatistical classification. He gives percentages of cognates between Central Dani dialects ranging from 76-92; between Central Dani and East Ngalik at Anggaruk and Kiniageima from 57-69, as can be seen in Table 2.

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tr>
<td>Matrix of Percentages of Plausible Cognates (Central Dani and East Ngalik)</td>
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<tr>
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<tr>
<td>CENTRAL DANI</td>
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<tr>
<td>Py-Wodo</td>
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<td>MGV</td>
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<td>Hit</td>
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<td>Tang</td>
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<tr>
<td>E-NGALIK</td>
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<tr>
<td>Kiniag</td>
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</tbody>
</table>

(Note: This Table is as given by Bromley with the exception of adding subfamily classification, changing dialect abbreviations to conform to those of this paper, and give only the percentages based on Swadesh's list, rather than Swadesh's and Bromley's modified list.)

Bromley cites Nduga dialects as sharing an average percentage cognition of basic vocabulary with Central Dani of 63%, and those of Wano about 60%. My own data reveal a range from 63-82% between Wano and Central Dani. However, this is probably unusually high, since one dialect included in my comparison is from lower Jamo, an area where Wano has borrowed heavily from
Western Dani, the dominant population of the valley.

1.3 Damal (or Uhunduni, or Amungme)

The third family (or family-level isolate), and next in size, is Damal. Damal dialects are all mutually intelligible even though speakers are dispersed over an area south of the Puncak Range all the way from just east of the Wessel Lakes to a point about south of 71°om where they meet the Nduga, and north of the Range are found in a number of valleys including Ilaga and Beoga. John Ellenberger of the Christian and Missionary Alliance has done extensive research on Damal. My Damal data come from him.

1.4 Dem

Dem is the smallest language group in our study. Dem speakers total about 750. They occupy pockets in the lower Jamo and live in close proximity to the Wanis. Though early to be discovered (see Le Roux, 1926), because of their size and peripheral location to our interior posts, little recent work has been done on Dem except by Ellenberger and myself on short visits into their area and through occasional contact with Dem speakers visiting us in Ilaga.

1.5 Purpose

One of the purposes of this paper, besides that of merely demonstrating genealogical links between the families, will be to submit evidence for classifying all four families as members of a single stock. A second is to carefully examine the core vocabulary and classify it according to the degree to which it is shared by all dialects of the stock. If a given vocabulary item is cognate with all dialects of all four families, the assumption will be that it is more stable than an item which links only two families. A third objective will be to not only compare and contrast cross-family rates of retention with geographic distributions, but to plot the distributions of cognate sets and subsets of the vocabulary items across family lines, and from these infer some of the possible historical relationships and movements between the proto-populations.

2. Basis for Cognition

Swadesh's 100-word list was not entirely satisfactory as a core vocabulary check, since I had to eliminate nine items for the following reasons: (1) because they were unknown to the interior (#29 Fish, #41 Horn); (2) because they were too difficult to match (color terms: #66 Red, #97 White, #100 Yellow, plus #47 Lie Down); and (3) because the term matched was the same root already matched by another item (#19 Drink and #12 Burn/Consume already matched by #23 Eat; #36 Hair by #27 Feather; and #3 Bark by #75 Skin).

All items which demonstrate cognition between dialects of two or more of the families are listed in Appendix A. They are given in a descending order, from those which occur as a single cognate set between all dialects of all families, to those which are cognate between only a single pair of dialects between families. The first number of each item indicates the order in the list; the second in parenthesis, the order found in the Swadesh list.

For any given item, dialect pairs received a plus one (+1) cognition reading, first, if the only difference between them was one or more of a series of correspondent sounds:

50. CLOUD (14). KIN/Ndug -kena, kena1, MGV/LGV -hena, Angg kena, wo kuni, Mo tinu.

Three series of correspondent sounds: k - h, t - τ, g - g, g - g.
-1; -2; -u (plus the final glottal in Ndug not found in the others). Each dialect in this series received a +1 reading with the others: Kin with Ndug, Kin with MGv, etc.

For most items the difference between the forms was more than just one or more series of correspondences. There were also differences which required postulating losses, additions, reductions, etc. during the historical development of the forms:

9. **BONE (10):**
   - Wan/WD/UGV/Angeg owak, MGv/LGv oawk, Ndug owa.
   - Kin wak, Dem awk, Mo iwa, Damal (n)ak.

Three series of correspondences: a, -a, -a; i, -i; -e, -e; -k, -l.

One loss and one reduction: *-k of proto-Mo was lost by virtue of the open syllable system which developed in EkWoMo; reduction of *owa- (or *oa-) of proto-Damal to o-.

For verbal items these stipulations for cognition were applied only to the verb stems:

24. **KILL HIM (43):**
   - Wan/WD/UGV/Angeg wat-, MGv/LGv was-, Kin wae, Ndug wae, Wo haw-, Dem e-.
   - Mo wak-, wat-, wa-, Ek wak-

Three series of correspondences: w, -e, i; -a, -a, -u, -o; -i, -e, -e, -l, -k.

However, with some verbal items, there was a cognate verb-stem set which, though linking most dialects of all families, occurred with only one inflected form in some dialects, but with all or most forms of the verb in the others. For these items, the dialects in which the form occurred with limited distribution received only a +½ cognition reading with those whose forms had unlimited or almost unlimited distribution:

11. **COME (16):**
   - Ek/WD/Mo me-, Dem me-, men- ?, Danal mo-
   - WD omv, MD omv, GD emv.

Assuming the correct Dem form is me- and not men-?, there are two series of correspondences identified: e, -e, -a, -e, -u.

Here, because the stem form in EkWoMo, Dem and Damal dialects occurs with all or most forms of the verb, but in Dani dialects only with the second person singular imperative, the former each received a reading of +½ with each other, but only +½ with each of the Dani dialects.

Dialect pairs also received only a +½ reading for other items because of compounding. Some items, for example, had a cognate set which ran through the whole stock, but for some dialects the form was a member of a compound, for others not:

6. **SKIN/BARK (75):**
   - Ek kado, Wo ebado, Mo ada, Damal ikip,
   - Dem atan, Wan akapelko, WD akapel, akapelko,
   - akapel, Wodo akado, MGv atdo, LGV/Ngalik
   - akapi, Ndug apoto.

This item is particularly interesting because it is the extreme of the extreme variation between cognate forms and the proposed sequence of change inferred in their development. If we reorder the forms this becomes clearer:

```
  ada  Mo
  ebado  Wo
  kado  Ek
  atdo  MGv
  akapelko  FyWodo
  apoto  Ndug
  akapelco  WD
  akapel  LGV/Ngalik
  ikip  Damal
```

It is highly probable that a form similar to Akapelko, probably *akapedo > *akatdo and *atdo in Mid and Upper GVD, and from these, EkWoMo kado, ebado and ada have emerged. On the other hand, the first morpheme akap apparently separated from *-do, remaining akap in LGV/Ngalik and becoming ikip in Damal.

However the development, dialects of LGV/Ngalik and Damal received only a +½ retention reading with the others for this item.

Some compound forms appear to have divided, forming two
cognate sets from each member of the compound (or to have been compounded from two converging sets), such that set x is partially cognate with xy, and xy with y, but not y with x. Item 29 MOUNTAIN illustrates such a cognate chain:

\[
\begin{align*}
\text{Mo} & \quad \text{DAM-A} \\
\text{DAM-I} & \quad \text{WANO-J} \\
\text{WD} & \quad \text{WD-UpPy} \\
\text{Ndug} & \quad \text{UpGV/MGV/Ngalik} \\
\text{Dem} & \quad \text{Dem}
\end{align*}
\]

I postulate that each member of the x set is cognate with the first morpheme of the xy forms, and each y member with the second of them, and therefore WD/Ndug received a +½ retention reading both with Mo/Damal/Wano-J and UpGV/MGV/Ngalik/Dem for this item.

Finally, where two words in one dialect cover roughly the same area of meaning as that covered by one in another, and one of them is cognate with the latter, then the dialect pair was also given a cognate reading of +½:

17. STONE (81): LGV kēlep, Ngalik kēlep, Ndug kētep, Damal-I kēla, Ko ngeda, homa, Dem nga.

While in Moni, ngeda carries the meaning of 'small rock' and homa of 'large stone', forms in LGV/Ngalik/Ndug/Damal-I/Dem are cognate only with the first Moni form, but cover an area of meaning of both. Moni therefore received a +½ reading with each of the LGV/Ngalik/Damal-I/Dem dialects.

3. Rates of Retention and Reclassification

In Table 3 the rates of lexical retention between all dialect pairs between families are summarized in a single matrix.

The sequence in which the dialects are listed is roughly parallel to their west-to-east geographic distributions: those on the horizontal axis from Ekagi to Dem; on the vertical axis from Damal-A to Ndug.

At each intersection five readings are given. The first is the percentage of the most stable of the core vocabulary shared by the two dialects, the second the next most stable, and the third, the least. The two right-hand readings are the totals of these readings: the first, the total of the two more stable ones; the second, the total of all three. The latter, thus, represents the total cognate percentage between the two dialects.

This threefold classification is based on the degree to which the core vocabulary exhibits cognation between the four families. Items of the most stable grouping each constitute a single cognate set linking all dialects of all families, or at least some dialects of all families. The first 18 items given in the word lists of Appendix A fall into this grouping (see Section I-A, items 1-8: EAT, FEATHER, I, LEAF, SPEAK, SKIN/BACK, THOU and WE which link all dialects of all families; Section I-B, items 9-18: BONE, BREAST, COME, EYE, GREEN/RAW, MEAT, NOSE, STAND, STONE and SWIM which link some or most dialects of all families). Readings on this most stable vocabulary are relatively high (ranging from 9.3% between Ek-Ndug to 18.1% between Ilaga Damal-Kinai), and thus represent solid evidence for affirming common geneological origin for all dialects. Each item is a member of the most fundamental core vocabulary of the stock which has tenaciously resisted decay and probably reflects the earliest stratum of its proto-vocabulary. 7

The second reading is based on cognation between dialects from any combination of three families as given in Sections II-V of Appendix A. The tri-family groupings are given in an order by section according to how they cluster moving from east to west:
Table 3
Rate of Retention Between Dialects of EKWoMo, Damal, Dem, and Greater Damal

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<tr>
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<th>Dam-A</th>
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The addition of the second somewhat less stable readings brings the range of rates of retention between dialect pairs up from 14.5% (Dam-Ek) to 27.4% (Xiniq-Dem).

The third reading is based on cognation between dialects within family pairs as given in Sections VI-X of Appendix A. These also are given in an order parallel to their east-to-west geographic distribution:

VI. Greater Dani-Damal
VII. Greater Dani-Damal
VIII. Greater Dani-EKWoMo
IX. Damal-Damal
X. Damal-EKWoMo
XI. Damal-EKWoMo

Though low (from .0% between Ngalik-Ek to 3.8% between Damal-Ek), when added to the more stable readings, the total cognate percentages between dialects come to from 15.9% (between Ndug-Ek) to 33.5% (between LGV-Dem).

To date, the four language groupings under study have been classified in two ways:

1. Separate stocks, or stock-level isolates, but all members of the same microphyllum (Bromley, 1967).

2. EKWoMo (Wissel Lakes - Kemandoga) as a separate family and Damal (Umunduni) a separate family-level isolate of the same stock, and it, with Dem and Greater Dani (including Kwerba) as separate stocks or stock-level isolates within the Greater Trans-New Guinea Phylum (C.L. Voorhoeve, 1975, 1976, and S.A. Wurm, 1976b). 8

If the basis for classification remains the same as in our 1972 paper on EKWoMo (28-39% of shared cognates: languages of the same family; 12-27%: languages of same stock), then with these relatively high retention rates of from 15.9% to 33.5%, we
are forced to include not only Damal and EkWoMo as members of a single stock as Voorhoeve and Wurm have done, but also to include Greater Dani and Dem. In fact, even without including the less stable cognate vocabulary represented by the third readings in Table 3, the retention rates are still high enough (from 14.5-27.4%) to include all dialects of all families as members within a single stock.

Retention rates of Table 3, however, reveal that Dem shares from 29.2 - 33.5% of its core vocabulary with Greater Dani, high enough to classify Dem not just as a member of the stock, but as a subfamily-level isolate within Greater Dani. Despite the high retention rate, I suggest this cannot be done for two reasons: (1) because the Dem - Greater Dani readings are more suspect to possible skewing through borrowing than perhaps are those between the other families, and (2) because of the distinct pronominal system Dem in part shares with Damal as over and against Dani and EkWoMo.

Dem speakers number but a handful (500-750) compared with their more numerous Dani neighbors with whom they have lived in close proximity for generations (besides Dem there are about 16,000 Western Dani and 1,500 Wano in Jamo alone). Whether or not the Dem have been proportionately more numerous in previous generations is conjectural, but their location in the lower Jamo right on the western border of the intrusive Western Dani would suggest this. With the Wano, who are also relatively few in number and living in the same relative proximity to Western Dani as the Dem, there is definite evidence of borrowing from Greater Dani. For example, Jamo Wano shares 77.5% of its core vocabulary with Western Dani, while Turumo Wano only 65.4%. I predict that vocabulary checks of Dem groups further west will reveal less shared vocabulary with Dani than do the lists of this study. A comparison of Ellenberger's and my lists with

that of a portion of the Le Roux Dem list given by Voorhoeve in his 1976 classification of Irian Jaya languages would suggest this.9

But even if such checks still reveal a higher than 28% cognition between Dem and Dani, Dem's distinctive pronominal system with Damal makes me hesitate to include it as a subfamily isolate of Greater Dani.

Examples of personal pronominal systems, one for each family or family-level isolate, are given below, except in the case of EkWoMo where, because Mo distinguishes gender in 3rd person singular and EkWo do not, both Mo and Ek are given:

<table>
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<tr>
<th></th>
<th>Person</th>
<th>Singular</th>
<th>Dual</th>
<th>Plural</th>
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<td>EkWoMo:</td>
<td>Ekagi</td>
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<td>1st</td>
<td>an</td>
<td>isai</td>
<td>ini</td>
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<td>2nd</td>
<td>aki</td>
<td>akai</td>
<td>ikii</td>
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<td>3rd</td>
<td>okai</td>
<td>okeyai</td>
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<tr>
<td>Moni</td>
<td>1st</td>
<td>a</td>
<td>ena</td>
<td>u</td>
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<tr>
<td>2nd</td>
<td>aka</td>
<td>iya</td>
<td>iki</td>
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<tr>
<td>3rd</td>
<td>oko ( masc)</td>
<td>uiya</td>
<td>u</td>
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<tr>
<td>Dani:</td>
<td>Western Dani 1st</td>
<td>an</td>
<td>nit</td>
<td></td>
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<tr>
<td>2nd</td>
<td>kat</td>
<td>kit</td>
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<tr>
<td>3rd</td>
<td>at</td>
<td>it</td>
<td></td>
<td></td>
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<tr>
<td>Damal:</td>
<td>Damal (I) 1st</td>
<td>nɛwɔ</td>
<td>henɔŋ</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>nɛwɔ</td>
<td>henɔŋ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>ëmɛ nɛwɔ</td>
<td>nɛwɔ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dem:</td>
<td>Dem (Pina) 1st</td>
<td>no</td>
<td>yu</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>aj</td>
<td>yu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>ŋa</td>
<td>yye</td>
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</tbody>
</table>

Dem and Damal, as can be seen, share with Dani a system with only singular and plural contrast as over and against EkWoMo which provides for a singular, dual, and plural contrast in number. Dem and Damal, however, differ from Dani in the fact that each has no contrast between 1st and 2nd person plural (though Damal does have the second form, nɛnoŋ, 1st pr-pl), whereas Dani, as well as EkWoMo, do. This difference, along
with correspondingly significant structural differences between the verbal inflectional systems of Dem and Dani, lead me to keep Dem as a separate family-level isolate within the stock.

I propose, then, that the reclassification be as follows:

**CENTRAL IRIAN JAYA HIGHLANDS STOCK**
(or CENTRAL IRIAN JAYA HIGHLANDS – KWERBA STOCK)

1. Greater Dani family
   1.1 Central Dani subfamily
   1.2 Ngakik-Nduga subfamily
   1.3 Wano subfamily-level isolate

2. Dem family-level isolate

3. Damal family-level isolate

4. Ekwomo family
   4.1 Ekgi subfamily
   4.2 Wodani subfamily-level isolate
   4.3 Moni subfamily-level isolate

The order in which the families are listed is from east to west in an order from highest composite retention reading to least according to the following pattern of family pairing: 1-2, 2-3, 2-4, 1-3, 3-4, 1-4 (where 1 with 2 is highest and 1 with 4 is lowest):

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<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Dem - Dem</td>
<td>30.9%</td>
<td>27.8%</td>
<td>24.3%</td>
<td></td>
</tr>
<tr>
<td>Dem - Damal</td>
<td>27.8%</td>
<td>21.4%</td>
<td>20.0%</td>
<td></td>
</tr>
<tr>
<td>Damal - Ekwomo</td>
<td>24.3%</td>
<td>20.0%</td>
<td>19.7%</td>
<td></td>
</tr>
</tbody>
</table>

However, when retention readings between individual language pairs across family boundaries are compared, the pattern is not clear-cut as these readings would suggest, but overlapping and skewed.

4. Cross-family Subclassification and Historical Implications

Table 3 reveals a number of interesting differences in the rates of retention between dialects over family boundaries, particularly between those of Ekwomo and Greater Dani. These cross-family links are not clear-cut by family, but overlap such that the picture we have is not one of a tree where each family branches off from the trunk and each language from a single branch as one might wish. Rather, it is as if the stock were a mosaic and the vocabulary the individual pieces of colored glass or stone making up the total design. The picture which results is quadriparti with overlapping colors and inter-penetrating motifs. Some colors run from one edge of the mosaic to the other (the cognate sets which link all dialects); others are broken and give distinction to one or more parts of the fourfold pattern.

In this section I will attempt to unravel some of the pattern; to identify linking languages between the families, note in greater detail some of the distributions of shared vocabulary, and make a number of inferences concerning the historical distribution and movement of the early populations.

4.1 Retention Rates: Some Observations

If we look at Ekwomo readings with the dialects of the other families, there is, with one exception, always a reduction in the rate of retention as one moves west away from the other families: Moni shares more of its vocabulary with the other families than Wodani, Wodani a bit less but more than Ekwomo, and Ekgi least. For example, Damal-A has readings of 21.8% with Mo, 19.5% with Wo, and 18.3% with Ek; Western Dani 21.8%
with Mo, 18.9% with Wo, and only 17.3% with Ek. This is what one would expect. Languages in closer proximity to each other share more of their core vocabularies. The only exception is Dem which shares more of its vocabulary with Wo (26.9%), next with Mo (24.7%), and least with Ek (23.5%).

On the other hand, the opposite is true when we turn to Greater Dani. Instead of finding the languages in closest proximity sharing the highest readings, they most often share the least. In fact, there is gradual rise in the rate of cognition as one moves away from EkWoMo, Damal and Dem groups down the North Baliem through the Grand Valley and on eastward to Anggaruk. Not until one passes Hitigima and Tangma in the Lower Grand Valley is there a leveling off, and in the case of Damal with Greater Dani, the retention continues to build up right on to Anggaruk of East Ngalik.

Wodani readings with WD, UpPy, Wodo, MGV, Hit, and Tang illustrate the west-to-east build-up of retention between EkWoMo and Greater Dani:

- 18.9%, 21.6%, 21.7%, 22.3%, 22.3%, 22.2%, 21.2%

The peak is at MGV and Hit. The same sequence with Moni reveals a similar gradual rise and rather abrupt fall:

- 21.7%, 22.3%, 22.3%, 25.0%, 29.4%, 25.0%

Although Dem and Damal each share slightly more vocabulary with Wano and Western Dani than with UpPy (their three closest Dani neighbors moving west to east in the order given), from UpPy down the Grand Valley east, their readings also illustrate this build-up. With Dem the readings climax at Tang, and with Damal at Tang and then hold on straight through to Ang. Dem with UpPy, FyWod, MGV, Hit, Targ, Kiniag, Angg read:

- 29.6%, 29.6%, 33.0%, 33.5%, 33.5%, 33.0%, 29.2%

while Ilaga Damal with these same dialects read:

- 20.5%, 20.6%, 22.3%, 25.5%, 25.5%, 25.0%, 25.5%

Whatever else these west-to-east build-ups of cognate retention may mean, they surely suggest that during periods of intensive differentiation between the proto-dialects, early LGV must have continued to exert more influence on the ancestor groups of EkWoMo and Dem more persistently and longer than those of the other proto-Dani dialects. Similarly, speakers of proto-East Ngalik must have lived in closer proximity to those of proto-Damal than they do now. Perhaps the answer lies in assuming that sizeable groupings of early LGV and East Ngalik speakers migrated westward into areas already occupied by proto-EkWoMo and Damal, much like Western Dani groups today can be observed moving out from the North Baliem into valleys north and farther west.

A third observation from Table 3 is that Moni serves as a linking language between the two larger families of EkWoMo and Greater Dani. Though remaining well within EkWoMo and sharing over 40% of its basic vocabulary with Wodani and over 50% with Ekagi, its retention rates with Central Dani are consistently higher than those of the other languages except Dem:

- from 21.7% (Mo-WD) to 29.4 (Mo-Hit), as contrasted, for example with the rates of Wodani and Central Dani: from 18.9% (Wo-WD) to 22.3 (Wo/MGV/Hit) or of Ilaga Damal with Central Dani: 20.6% (Ilaga Damal - UpPy/FyWodo) to 25.5 (Ilaga Damal - Tang/Kiniag/Anng).

However, when only the more stable vocabulary is compared (total of first and second readings at each intersection), though Moni readings with Central Dani are still higher than those of Ekagi or Wodani, they are lower than those of Damal with Central Dani:

- Moni with Central Dani range from 17.9% (Mo-WD) to 22.7 (Mo-Hit) while Ilaga Damal with Central Dani are from 19.5% (Ilaga Damal - UpPy/FyWodo) to 24.4 (Ilaga Damal - Hit/Tang).

This suggests that Moni's higher rates with Central Dani are the result of closer proximity to proto-Dani in the more recent history of the stock.
4.2 Vocabulary Distribution: Some Propositions

Earlier it was pointed out that the vocabulary items in Appendix A are classified according to their degree of cognation between families. Sections I-A and I-B include items whose forms constitute a cognate set between all or most dialects of all families, those of Sections II-V with dialects of combinations of three families, and those of Sections VI-XI, between those of any two families. This classification of sets according to the degree of cognate penetration between families has much to tell us concerning the historical development of the stock. I will express this information in terms of a number of propositions, grouping them according to the subclassification of vocabulary given in Appendix A.

1. Where all dialects of all families are members of a single cognate set (see Section I-A).

Proposition 1. If all dialects of all families are members of a single cognate set, the phonological differences between subsets tend to follow family boundaries:

- BAT (1) has two cognate subsets: EkWoMo/Damal na- and Greater Dani/Dem na-, nTV-, or na-, nTV.

- I (3), THOU (7), WE (8), the three personal pronoun items in the vocabulary list, each form cognate subsets by family, with the more similar tendencies to be grouped by family pairs as follows:
  - Greater Dani (EkWoMo) (Dem Damal):
    - I  THOU  WE
      - Greater Dani an  kat, hat  nit, nis
      - Ek    ani  aki  ini
      - Wo    nii  akai  ini
      - Mo    a    aka   i
      - Dem   no, nou  ag  yu
    - Damal-A nAVO  nAVO  yenog
    - Damal-I nAVO  nAVO  henog, nenog

SPEAK (5) has separate subsets which tend to cluster by family as follows:

Ek et-; Wo hen-; Mo hind-, hen-; Damal há-; ha-; Dem a-
Greater Dani IV, TV, Y, 'Y.'

I suggest these items reflect the earliest stratum of proto-vocabulary, since cognation is between all dialects of all families and the subclassification is by family. It would appear that during this earliest period of diversification of the stock, proto-Dem and Damal remained closer to each other than any other proto-family pair.

Proposition 2. If the difference between subsets does not coincide with family boundaries as is stipulated in Proposition 1, then the most pronounced difference is between EkWo and the rest of the stock, with subclassification generalized as follows: ((Ek Wo) (Mo (Damal (E-Ngalik (Wano/Central Dani/ Nduga) (Dem))))).

LEAF (4). EkWo iva: Mo hoks; Damal nokol; E-Ngalik egela;
Central Dani/Wano/Nduga ego, iga, ekki; Dem esi.

See also FEATHER (2).

After the first cut between EkWo and the rest, the distribution is layered hierarchically as if each grouping could be peeled off, first Moni, then Damal, and finally E-Ngalik from Central Dani/Wano/Dem.

This vocabulary, I suggest, is also very early. It links Damal and Moni closer to the eastern half of Greater Dani (E-Ngalik, Nduga, and often LGV) than to the western half (Wano and Central Dani, sometimes including LGV, sometimes not).

The only other item in Section I-A which does not comply with Propositions 1 and 2 is number 6 SKIN/BARK. For an interpretation of its subset distribution, see comments earlier in Section 2.

2. Where all families are linked by a single cognate set, but not all dialects of all families (see Section I-B).

Proposition 3. If the stock breaks into two or more cognate
sets, such that one still links all families, the first most
important break is between Wo and Mo, pitting EkWo against Mo
and the rest.

BONE (9). (EkWo) (Mo (Dem (J-Wano/Central Dani/E-Ngalik/
Ndug))) (T-Wano):

EkWo mitoo; Mo iwa; Dem awak; J-Wano/Central Dani/E-Ngalik/
Ndug awak, owa, owa1, wak; Tur-Wano egit.

See also numbers 12 INE, 15 NOSE, 17 STONE and 18 SWIM.
This argues for an early separation between EkWo and Mo, with
the latter continuing in close proximity with early Dani, Dem,
and Damal.

Proposition 4. If there is a second break resulting in
three cognate sets, one of which still links all families, the
break lops off Greater Dani dialects to the west to form a
separate block comprised of Wan and WD, as opposed to the rest
of Greater Dani, Dem, Damal, and Mo. If this western block of
Greater Dani extends further east to include Grand Valley Dani,
thereby placing Wano and all of Central Dani against E-Ngalik/
Ndug, Dem, Damal and Mo, the tendency is for Wo and even Ek to
be included in the latter and main set. That is to say, the
more inclusive the center block, the more the tendency of the
main set to reach westward into EkWOmo, linking more closely the
two east-west extremities of the stock: E-Ngalik/Ndug with
EkWo.

STONE (17). (Ek) (Wo) (Wan/WD) ((Dem) (Mo (Dam-I (GVD/E-
Ngalik/Ndug)))):

Ek mogo, Wo huma, Wan/WD yukum, Dem nga, Mo ngeda, Dam-I
kela, PyWodo gis, MGV helekit, LGV helap, E-Ngalik
Keler, Ndug Keler.

MEAT (14). (Ek) (Wan/WD) (Mo (Wo (Dem (GVD/E-Ngalik))))

Ek mogoe, Wan egasum, WD egasum, Mo hu, Wo ol, Dam nain,
Dem amul, alina, Uroy uno, PyWodo/MGV/Ndug ino,
LGV/Kiniak ino, Angg unu.

BREAST (10). (Wan/Central Dani) ((EkWo/Dem/Ndug) (Dem/
E-Ngalik)):

Wan aidak, WD elak, PyWo aidak, MGV idak, LGV allak,
EkWo/Dem, Dem ahi, Ndug ahi, Dam-A nakam, Dam-I
nadh, Kiniak akamu, Angg ak.

I would suggest from this that LGV Dani, and possibly
E-Ngalik, more nearly reflects proto-Dani than the other Dani
dialects, since it is, above all others, almost always a
member of the main cognate set which links all families when
the others are not. I further suggest that the frequency
with which the western dialects of Greater Dani are part of the
third set is in proportion to their time depth of separation
from more central proto-Dani: Wano scoring highest and there-
fore reflecting the earliest separation, Western Dani next,
and Upper and Mid-Grand Valley lowest, and therefore a later
separation.

3. Where Greater Dani, Dem, and Damal share vocabulary
which is distinct from EkWOmo (see Section II, Appendix A).

Proposition 5. When dialects of Greater Dani, Dem, and
Damal form a cognate set distinct from EkWOmo, all dialects,
or all but Wano, of Greater Dani, Dem, and Damal are cognate
most of the time, and the differences in form between the sub-
sets tend to fall on family boundaries (but not necessarily
subfamily boundaries), much as was the case with the most
fundamental vocabulary described under Proposition 1 above:

BAR (19). (Ek Wo) (Mo) (((Damal) (Dem)) (((Wan/WD/UpGV/MGV)
(LGV/E-Ngalik/Ndug))):

Ek papa, Wo ngonada, Mo yawa, Damal neloi, neloi, Dem padep,
Wano/WD/Up-MGV nattok, nattuk, masuk, E-Ngalik/Ndug
asaak, asaag, etc.

See also numbers 20 FOOT, 21 HEAD, and 22 WHO.
I would argue that at least items 19, 20, and 22 are
members of a very early stratum.

4. Where Greater Dani, Dem, and EkWOmo share vocabulary as
tending to be linked closer to proto-Ek and Wo, and Damal to proto-Mo.

6. Shared vocabulary between Dem, Damal, and EkWoMo, but not Greater Dani (see Section V, Appendix A).

**Proposition 6.** When dialects of Greater Dani, Dem, and EkWoMo form a cognate set against Damal, there is a tendency for all dialects of Greater Dani to be members of a single set with Dem and for members of EkWoMo to share in the set inversely to their present geographical distribution, just as was described in Proposition 4 above.

The one item which does not exhibit cognition between all Greater Dani dialects is 23 BLOOD. Here Wano and Western Dani form a distinct set. The other items are 24 KILL, 25 MOUTH/LIPS, 26 NAME, and 27 ROOT. Two sets reveal cognition with only Ek, #25, 27), one with EkWo (25), and another two with EkWoMo (24, 26). This gives retention readings for the languages of EkWoMo with Greater Dani and Dem for these five items of +5 for Ek, +4 for Wo, and only +2 for Mo, the opposite of what one would expect.

5. Where Greater Dani, Damal, and EkWoMo share vocabulary, but not Dem (see Section IV, Appendix A).

**Proposition 7.** When Greater Dani, Damal, and EkWoMo share vocabulary to the exclusion of Dem, the overwhelming tendency is to share it with EkWoMo in a manner opposite from that given in Proposition 6: instead of with EkWo to the exclusion of Mo, it is shared with Mo to the exclusion of EkWo. A-Damal and Wano also tend to be excluded.

**Other examples are 29 MOUNTAIN, 30 SUN, 32 TOOTH.**

I would suggest from Propositions 6 and 7 that in the early break up of the stock, proto-Dem and Damal tended to stay together, each in close proximity to proto-Dani, but proto-Dem
Proposition 10. Dem and Damal's early linkage is further substantiated by the five items they exclusively share (see Sections VIII-C and IX). However, when one compares the sets which link Dem exclusively with EkwMo (four items, see Sections X-A and X-B) with those which link Damal with EkwMo (two items, see Sections X-B and XI), just as with Greater Dani, Dem scores higher.

5. Conclusion

This paper had its beginning back in 1955. At that time I was less than a year into my study of Moni, seizing every opportunity to get sample vocabulary lists from distant groups which came to make ash salt at the Homeyo salt springs located right near us in the lower Kemandoga. The Beoga Damal were first, then a party of Ilaga Western Dani, and eventually representatives from Wodani, Wano, and Nduga were included in the survey, not to mention Moni and Ekagi. I first circulated a write-up on the linguistic relations between these languages in 1955, and later in 1957-58 while on furlough, wrote two papers elaborating more fully on the subject. One was a lexicostatistical study on EkwMo; the other on EkwMo, Damal, and WD-Nduga. The results of the first have since been summarized in the 1972 paper already referred to which my wife and I coauthored. The latter, long overdue for revision, has been incorporated into this paper.

The earlier readings between EkwMo, Damal, and WD-Nduga of Greater Dani (the extent of our survey at that time) revealed very low cognate retention, ranging from a mere 4.3% (Beoga Damal with Ilaga Western Dani) to 11.6% (Momi with Nduga). Today, with a more thorough knowledge of each language and a broader perspective with more dialects in the study, the percentages between these nearly same pairs are calculated at 21.1% (Ilaga Damal with Western Dani) and 22.5% (Momi with Nduga).

In 1955 we did recognize some of the most persistent items to resist change (EAT, THEOU, I, and SPEAK), and therefore postulated common genealogical ties. Today we are able to say these groups are all members of the same stock.

An important study remains to be done. Using the comparative method, a careful analysis should be made postulating not only the proto-phonologies (as Bromley has already done for Dani, see Bromley, 1961), but also reconstructing a sample segment of the early vocabulary of the stock. Some of this work has been begun, as was illustrated earlier in the paper (see Section 2). A further example is the following reconstruction of the proto-form for FEATHER (2):


Each is postulated to be traceable to a proto-form, probably *iti. During its course of change, initial *i- became either mid e- or low a- in Greater Dani, Dem, and Damal, but remained high front in EkwMo. On the other hand, while in all but Damal of the former, the final vowel either remained high front or, as in Mo, Wano, and Ngalk, moved from front to back -u (a phenomenon commonly found between present dialects), in EkwMo it moved down to -e, resulting in a *i- > -e- development. Final *e- undoubtedly emerged late in Damal, Wano, and Angg, and it in turn conditioned the lowering of *-u- of proto-Damal to present -e-. The final *-k, if in proto-Mo, was lost because Mo, along with EkwMo emerged with an open syllable system. The development of *-i- > -e- in MGV/UGV/E-Ngali is also late, and undoubtedly its rise in part is conditioned by the high front final vowel. At present, I have no explanation for why *-i- > -ati- in Damal.

When such a comparative study is completed, then the inferences made in this paper concerning the early distribution and movements of population and the influence each family has
exerted on the other as it has emerged can be more firmly confirmed or denied. Some of the inferences were:

1. There is a basic east-to-west diversification and development of the stock. Evidence for this was seen first in the east-to-west decline form highest to lowest percentage of shared vocabulary between family pairs, with Greater Dani and Dem highest, and Damal and EkWoMo lowest (see last paragraph, Section 3). Second, in the analysis of the development of individual forms of a cognate set, it was almost always easier to account for losses, reductions, and other kinds of phonetic change if one began with Grand Valley Dani and worked through the stock westward, rather than the reverse (compare examples in Propositions 3 and 4). Another reason for believing the stock developed out from the east is because Lower Grand Valley Dani was seen to persistently share higher cognate readings with dialects of other families than all other Dani dialects, and as one moved in either direction from this point, particularly from east to west, the percentages tapered off (see Section 4.1). I have suggested that it, more than any other Dani dialect, reflects proto-Dani, and is crucial to an interpretation of the inter-family links within the stock.

2. If we were to suggest a sequence of separations during the early diversification of the stock, and do so without regard to neighboring groupings within the broader linguistic setting (that is, to treat the stock as if it has been an independent isolate over the centuries\textsuperscript{14}), then the assumptions we have made would read something like as follows:

   During the earliest period the stock millennia ago, separations tended to follow family lines (see comments under Proposition 1), with proto-EkWoMo moving somewhat further from Greater Dani than Dem and Damal (see Proposition 7). Members of the latter pair, I suggested, were more closely linked than were other proto-family pairs, and so long as they stayed together, each continued in relatively close proximity to proto-Dani (see Propositions 7 and 9). However, once early Damal speakers severed their close ties with those of Dem, they lost close contact with early Dani also, while the former did not. Instead, Dem must somehow have remained in relatively close proximity to both emerging Dani as well as EkWo, but not Mo (see Proposition 7). In the meantime, as Mo moved away from EkWo, it was, as it were, pressed back eastward into closer contact with not just early Dani (see Proposition 3), but also closer contact with early Damal (see Proposition 5). For this reason, it was argued, Mo shares a relatively high retention reading with Greater Dani and is to be considered a linking language between Greater Dani and EkWoMo (see third observation, Section 4.1). More recently, Damal must have moved still further from Dani and Mo, while Mo has continued in close proximity to Dani (see third observation, Section 4.1, and comment under Proposition 9).

3. Diversification of the stock was considered to be not just the result of a gradual separation of populations, moving in general from east to west, but in part explained by periodic migrations out from the more heavily populated eastern valleys into the less settled western areas (see second observation, Section 4.1). It would appear that one group had no more than separated and begun to acquire its own distinction when the parent grouping from which it had severed ties followed suit and also moved into the newer area. The pattern, I suggest was one of gradual separation and change, followed by migration and modified change, or even mixing.\textsuperscript{15}
4. Tradition and recent migration would support at least the more recent east-to-west development of the stock. All groups from the Balies west affirm that their ancestral groups came from either the Grand Valley or an area east of the Balien. In the case of the Western Dani, they continue in their tradition. They are part of a sizeable movement out from the North Balien, some migrating northwest into the Swart and Jano, others westward into the valleys of the upper Rouffaer as far west as into the Dugindoga.

NOTES

1 Besides serving under the Christian and Missionary Alliance, I am with Myron Bromley and John Ellenberger, one of the three Honorary Translator's Advisors for Irian Jaya with the United Bible Societies.


3 Morris Swadesh, following Sapir (1916), is the one most responsible for the development of lexicostatistical procedures in the United States. Lexicostatistics (also referred to as Glottochronology) assumes that the basic vocabulary of all languages tends to resist change at the same relative rate. Therefore, if two languages are found to share a high percentage of their core vocabularies, it is assumed their time of separation is relatively recent, and similarly, if the percentage of cognation between them is low, their time-depth of separation is more remote.

Though there are various causes for vocabulary change—semantic substitution, shift in meaning, replacements due to borrowing, culture change— it is believed that all of these add up to a rate of change which, given a long time period, is considered constant for the most stable vocabulary. There has been much controversy over what constitutes universal basic vocabulary, and serious questions concerning whether it changes at a constant rate, even when calculated over a long time period. For an understanding of some of the basic assumptions and criticisms of lexicostatistics see Sarah C. Gudschinsky, 1956; D.H. Hymes, 1960; and Morris Swadesh, 1952, 1955.

4 For Moni these figures are based on my own estimates. Fifteen years ago government statistical reports listed Ekagi population from 60,000 - 65,000. Only more recently have estimates been given which list it at up to 100,000. Paul Burkhart, now in Honeyo and working on Wodani, gives the estimate for Wodani.

5 The word lists on Wodani, Moni, Dem, Wano, Western Dani (Pit) and Nduga I have recorded myself. Missionary linguists from the Christian and Missionary Alliance (CAMA) have either submitted lists for the other languages, or confirmed what I have recorded myself: Marion Dobie for Ekagi; Paul Burkhart, Wodani; John Ellenberger, Dasaal-A, Dasaal-I, and Dem; William Cutts, Moni; Mary Owen, Nduga; Myron Bromley, Western Dani (UpPy); Wodo-Pyramid, Mid-Grand Valley, Hitigima, and Tangma of Lower Grand Valley, Xiniageima, and Anggarik Yalimo of East Ngali.

6 The word for each dialect is given in an order which reflects subsets based on phonetic similarity between the forms. Each dialect is written in an orthography which is phonemic, or nearly phonemic, with one significant difference between Greater Dani and the rest: whereas the pre-nasalized stop series in Greater Dani is written b, d, g, kw and voiced stops as ŋ and ñ (these are in fact imposives), in the other languages these are written mb, nd, ng (where there is no labialized pre-nasalized velar stop as in Greater Dani) and b, d, g (where in Moni there is no voiced velar stop just as in Dani, and in Ek and Wo the velar voiced stop is laterally released). In all languages by Ek, k occurs with voiced velar fricative (g) in inter-vocalic position, and in all but Ek/MoMo g and t occur with voiced allophones (w) and (y) in the same environment.

7 Wurm and McElhanon point out that where comparative linguistic work has been carried out in stocks of the Trans-New Guinea Phylum, forms which can be shown to be reflexes of proto-forms reconstructed for the language group in question, contain some of the very items found here: at least one verb stem, either EAT or SAY, and two pronouns from the set I, YOU, WE (see Wurm and McElhanon, 1976).

8 I should hasten to add that, perhaps the very reason why these men did not classify all of these families as members of the same stock is because they based their conclusion in part on my earlier low percentages of cognation between the families given in unpublished materials which wouldn't permit them to do otherwise (see my comments on the earlier materials in the Conclusion).
9 Thirty-two items of the Le Roux list were comparable with Dem lists on which this study is based. Of the 32 items, our lists revealed plausible cognition readings between Dem and most Dani dialects of +17 as compared with +142 for the Le Roux list. The items on the latter which revealed zero or only partial cognition with Dani were NAME (+0), STONE (+0), and SKIN (+1). The one item on the Le Roux list which was cognate with Dani (Western Dani only), but not with our lists, was EGG. It, as well as SKIN, received a (++?) reading, since the two forms were given for the one item in each case. For the Le Roux list as given by Voorhoeve, see Voorhoeve, 1975, page 166.

10 I have no data on Kwerba other than the check list given by Voorhoeve in his classification of the languages of Irian Jaya (1975) and was therefore unable to incorporate Kwerba into this study. However, since Kwerba is, according to Voorhoeve, a member of the stock, it should be included in the name of the stock and listed as a separate family.

11 This is not a statement on the degree of similarity between LSV's present phonemic system with that of proto-Dani (for this see Bromley, 1961, pages 6ff), but only an evaluation on its degree of proto-vocabulary retention.

12 These papers were written as partial requirements for courses taken at the University of Michigan in 1957-58. They were entitled: Kapauku-Woda-Moni glottochronology: a study of the historic movement of peoples of central Netherlands New Guinea, Part I, and Kapauku-Woda-Moni, Uhunduni, and Lani-Ndauwa glottochronology: a study of the historic movement of peoples of central Netherlands New Guinea, Part II.

13 My wife and I have promised to submit such a study for publication as a monograph in the Pacific Linguistics Series. Other commitments have prevented us from doing so to date.

14 This of course is impossible if an accurate overall picture of the history of the stock is to be gained. Irian Jaya languages of the Trans-New Guinea Phylum (excluding those from Papua) are classified as members of 26 separate stocks by Voorhoeve (1975), and some share relatively high retention rates with Dani, Dem, Damal, and Ekwato. For example, Voorhoeve cites Semini, Mairsei, and Tanah Merah of the Mairaei-Tanah Merah stock as sharing from 8-16% of their vocabularies with Ekwato, Moni and Dani (see page 429, Voorhoeve, 1976). Asmat languages also share relatively high retention rates (possibly above 15% with all families by a comparison of those items on the Swadesh list which were in Drabbe's vocabulary lists in his 1949 work).

Despite the importance of the larger picture, for purposes of this paper, the historical inferences are valid, even if they only suggest remote relationships which must later be reinterpreted in the light of the broader focus.

The most up-to-date comprehensive work on the total Irian Jaya and Papua Linguistic situation, including a number of studies on the Trans-New Guinea Phylum, is S.A. Wurm, 1976a.

15 It would appear, however, that language mixing has taken place only when groupings were of about equal size and shared a relatively high percentage of their core vocabularies. If either group outnumbered the other by a large margin, it would appear that borrowing by the smaller group took place rather than mixing. If the populations were only remotely related linguistically (as is the present situation between Damal and Western Dani in Ilaga for example), the core vocabulary of each was probably little affected by the other.

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OBSERVATIONS ON THE HISTORY
OF HUMAN USAGE OF SUBALPINE AREAS NEAR MT. JAYA

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Ikhtisar


Dalam penelitian tersebut juga ditemukan sejenis binatang kangguru yang merupakan sesuatu hal baru dalam ilmu pengetahuan, dan sudah tidak ada lagi pada zaman sekarang.

Menurut penulis, gangguan manusia terhadap alam telah serjadi sejak 11.000 tahun yang lalu, tetapi, pengaruh akan itu manjadi hebat pada 2000-5000 tahun yang lalu. I.S.

This paper summarises the observations made in 1972 and 1973 by the first and second glaciers research teams on human usage of the high altitude areas around Mt. Jaya. It considers traditional ownership, trade routes, and hunting and also the impact of mining and climbing parties. Much of the vegetation between 3000 and 4000 meters on the north plateau is the result of burning and disturbance by man, but the southern face of the range is little changed. Both the Ertsberg mine and climbers have increased the numbers of Moni, Damal, and Western Dani visiting the area.

Two rockshelter deposits exposed by climbing parties were examined and dated to 5,500 years ago and 800 years ago. The older shelter, the Mapala, occurs at 3996 meters and contains a horizon rich in animal bone, including one kangaroo species new to science and apparently absent from the area today. A
vegetation history spanning 14,000 years was obtained from a nearby pond by pollen and carbonized particle analysis. This suggests that disturbance of the vegetation began as early as 11,000 years ago, but was especially heavy from 5000 to 2000 years ago. The possibility exists that the Mapala shelter was also utilised most intensively during this period, and that a relative extinction of game has led to lower level of usage of the last 1000 years.

**Foreword**

From December 1971 to March 1972 and again from January to February 1973, a team including surveyors, glaciologists, geomorphologists and biologists studied the glaciers of Mt. Jaya, in the western Sudirman Range. An account of the first glacier research expedition has already been published in the *Irian* (Champion et al 1973) and the scientific results have finally appeared as a book (Hope et al 1976). Although no anthropologist or archaeologist accompanied the expeditions, local guides and porters helped both expeditions and some data on local usage of the high uninhabited plateaux were gathered. In studying the vegetation and soils of Mt. Jaya, I came to the conclusion that human interference in the area must have had a long history, even though it appears to be rather light at present. This conclusion was borne out in two ways: a preliminary study of exposed sections of midden in two rock shelters showed a considerable history of past exploitation; and a vegetation history (using pollen analysis) that extends back to ice age times demonstrated burning and vegetation disturbance throughout the last 10,000 years.

This article reproduces material included in Hope et al 1976 and is mainly based on the chapter by G.S. and J.R. Hope. Besides bringing this material to a wider audience, this article aims to illustrate a technique available for assessing the history of man's interaction with his environment.

**A. MODERN EXPLOITATION**

**Local Populations Around Mt. Jaya.** Six major language groups live at mid-montane altitudes around the western Sudirman range, their territories being shown in Fig. 1 (data provided by R. Mitton). Table 1 provides rough population estimates and other data on the groups near Mt. Jaya.

![Language Groups Around Mt. Jaya](image)

The people are subsistence gardeners and pig raisers, depending on the major root crop, sweet potato (*Ipomoea batatas*). There are a wide range of minor crops such as taro (*Colocasia* spp.), sweet corn (*Zea mays*) and other vegetables listed by Cooper (1971) and Powell (1976). Their social patterns and life styles are well known, e.g. Allied Geographical Section (1943), Roux (1948-50), Poapalis (1963) for the Ekagi, Roux (1948-50), van Nune (1973), for the Moni, Ellenberger (1962) for the Damal, and Gardner and Heider (1968), Heider (1970), Peters (1975) for the Grand Valley Dani. The groups differ little generally in
their economies and lives except that the Moni and Damal have quite small populations. The Ekagi and Western Dani groups are the largest language groups in Irian Jaya. Most of these two language populations live in broad flat valleys at about 1,700 meters altitude. However, some of them, and the smaller groups, occupy small isolated valleys with populations from a hundred to a few thousands only, between 1,200 and 2,500 meters.

Physically the people are short and stocky although there is wide variation (Pospisil (1963) gives an average height of 151 cm for male and 142 cm for female Ekagi in the Kamu Valley). They have dark brown to light bronze skins and dark brown kinky hair. The men wear penis sheaths made from gourds and held on by a string around the waist, and the women very short skirts made from Elaeocarpus stam. Details of dress and ornamentation vary between areas but are extensively figured by Roux (1948-50) and Haddon and Layard (in Ogilvie-Grant 1916). The houses are usually made of upright planks split from logs and roofed with pandanus leaves or grass and sedge thatch. Large "villages" do not exist and households are often widely scattered through the agricultural area, but may group within a smaller area.

Traditionally, a subtle balance existed between trade and war, both within and between the neighboring valleys. Alliances were formed between different groups and these provided help in times of war and facilitated trade. The alliances were always breaking down and shifting ground, a fact which has hindered communications. Major requirements of these inland people were the small cowrie and larger shells which formed a currency, salt, innovative crop plants, and, after the 16th century, metal tools. In return they exported pigs, and also women to a certain extent, but trade with the coast must have always been difficult and dangerous.

At present fighting has almost ceased in the area and large scale wars are unlikely. Old enmities still smoulder and it is

<table>
<thead>
<tr>
<th>Group</th>
<th>Rough Population</th>
<th>Language</th>
<th>Other Names in literature</th>
<th>Main Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ekagi</td>
<td>55,000</td>
<td>Ekagi</td>
<td>Ekari, Me, Kapauku</td>
<td>Wissel Lakes, Eneratoli (M.A.P.)</td>
</tr>
<tr>
<td>Wolani</td>
<td>3,000</td>
<td>Wodani</td>
<td>Wodaa</td>
<td>Lower Keman-doga Valley</td>
</tr>
<tr>
<td>Moni</td>
<td>12,000</td>
<td>Moni</td>
<td>Migani</td>
<td>Hitalipa, Bilai (M.A.), Kugapa</td>
</tr>
<tr>
<td>Damal</td>
<td>15,000</td>
<td>Uhounduni</td>
<td>Uhounduni, Oehoendoeni, Dama, Amung</td>
<td>Ilaga, Boega (M.A.P.)</td>
</tr>
<tr>
<td>Amamedamal</td>
<td>4,000</td>
<td>Uhounduni</td>
<td>Kapauku, Amung</td>
<td>Jila (M.A.), Teings, Tabagapura (P.), Dumandora Valley</td>
</tr>
<tr>
<td>Western Dani</td>
<td>60,000</td>
<td>Western Dani</td>
<td>Dani</td>
<td>Ilaga, Tiom, Mulia, etc. (M.A.P.)</td>
</tr>
</tbody>
</table>

M: Mission station  A: Airstrip  P: Government station

unsafe for members of some clans to travel into specific areas. However, there are many accepted routes within group areas which serve to expand the resource range by making available the products of a range of environments. The most important of these is of course land at mid altitudes suitable for gardening, but the forest zones at different altitudes provide needed products, including building and fencing materials, fuel, fibers, and matting, and to some extent food. Above the garden limits set by occasional frosts (about 2400 meters) up to 3000 meters, the forest offers the fruits of the high altitude Pandanus, which can be smoked and stored unlike nearly all other highland crops.
Above 3200 meters the forest starts to give way to areas of swampy grassland and groves of tree ferns which offer few vegetable resources but which were probably the richest hunting grounds, since terrestrial animals are rare at lower altitudes, and arboreal mammals and birds are difficult to catch in the taller montane forest.

Hunting parties, of one to several men, usually with a dog regarded as especially suited to hunting, will spend several days in travelling to the subalpine areas, searching for animals such as possums, bandicoots, and long-beaked echidna or any birds, often returning with live animals to their villages. The animals have considerable value both for their meat, but also for the pelts.

The area between the Balaem River and Wissell Lakes, north of the crest of the Sudirman Range, includes the greatest extent of high country in New Guinea, with gently rolling plateaux up to 20 km wide and 40-80 km in length. The area above 3000 meters includes about 4000 km² of grassland, shrubland and subalpine forest mosaic. Observations on current usage have been made by several expeditions to Mt. Jaya or Mt. Trikora. The experiences of the glacier research expeditions are given in more detail for Mt. Jaya only, particularly the Kemabu Plateau which lies north and east of the glacier area, Fig. 2.

Ownership. The glacier area and high crestal ridges of Mt. Jaya appear to be claimed by Amume Damal from the southern villages of Tsinga and Waa. These people live about 10 km south of the mountain crest, at only 1,700-1,500 meters altitude, and garden on only a few square kilometers of cleared land in each valley (Fig. 2). Base camp was established by the first glacier expedition in the upper Meren at 4,250 meters on 20th December, 1971. On the 24th a stake bearing a cross had been placed near the tents with an indecipherable note, which a Waa

Settlements and Tracks in the Mt. Jaya Region

informant said had come from Tsinga Valley. Three men from Tsinga were hired at Tembagapura as field assistants on 28th December but found conditions too cold and suffered altitude migraines, leaving on 30th December and 3rd January, 1972. On 16th January thirteen Amume Damal from Tsinga appeared with another cross and ordered the camp vacated. About half had bows and arrows. The cold was so intense that they accepted shelter and food from the camp and returned to the mire where a six week stay was negotiated for the expedition. A similar claim
had been made in 1969 for the Ertsberg mine area (La Preinie, 1972). The attempted ejection of the expedition, despite permission for our stay having been granted by other Tsinga men was apparently the result of leadership rivalries at Tsinga. By the end of the expedition fighting had broken out in Tsinga and Waa over wife stealing and in 1973 several people were killed.

To the north of the range the Damal from Beoga appear to be the most familiar with the Kemabu Plateau. Roux (1948-50) mentions that large parties leave Beoga for extended hunting trips onto the plateaux, and Beoga Damal guided the Cenderawasih Expedition to Mr. Jaya (Hamid et al, 1964). The Damal guides and carriers accompanying the Mapala Expedition of the University of Indonesia in 1972 were familiar with the minor tracks, rock shelters, and huts from Beoga to Mt. Jaya. The 1973 glacier research expedition found a Damal hunting party occupying a shelter built by the 1972 expedition at Discovery Lake, but no other Damal were encountered by either expedition. By contrast, Western Dani porters and guides from Ilaga had only a poor knowledge of the Kemabu Plateau, although they were familiar with access tracks to the eastern edge. Harrer (1964), with Western Dani from Ilaga, did not know of the Mapala rock shelter near Lake Larson (see below) and guides to Temple (1962) were apparently not aware of the track beyond the Hogayaku Lakes. Two Western Dani guides recruited at Ertsberg mine by the 1972 expedition were also unaware of many of the tracks north of Mt. Jaya; they had reached the mine via the Bakopa Valley.

The degree of claim by Damal to the Kemabu Plateau area is unknown. Western Dani and Moni men are apparently able to cross the plateau because individuals from Hitalipa and Ilaga were present at the mine in 1972. Also there must be contact between Ilaga and Ugimba, an isolated Western Dani village on the Kemabu River. By contrast, all but one of the Damal porters to the

1972 Mapala expedition were unable to travel to Ilaga because of a then current feud. Thus it would appear that access to the plateau and Mt. Jaya is open, or at least not normally disputed, by the Damal of Beoga and to the south. Hunting rights may be defended more closely, but no data are available on this.

Tracks. The expeditions to Mt. Jaya, Colijn (1937), Temple (1962), Harrer (1964), Hamid et al (1964), Peterson (1973) and information provided by missionaries at Ilaga and R. Mitton provide the basis for the routes of tracks in the area. Locations are given by Hope et al (1976). The most used is the Kemandoga Valley - Ilaga - Baliem Valley which represents one of the most important trade routes in New Guinea. It links the Baliem Valley with its large population to the Wessel Lakes and ultimately Cenderawasih Bay and the northern coastal economy. The Baliem Valley also has strong links to the south over Mt. Trikora (Brass 1941). The northern rim of the Kemabu Plateau is traversed by one section of the east-west track, which branches from the Bilai-Hitalipa track, climbs onto the plateau and crosses it, descends to the Zengill River before climbing to the head of the Itu River and following the northern valley slope to Ilaga. It was examined from the plateau to Ilaga by the author. The section from Tion to the Zengillorong is described by Temple (1962). Except for Ilaga, this branch of the trade route avoids population centers or even habitation for most of its length, and the open, high altitude grasslands allow rapid travel. Thus in the past, individual groups were probably able to travel over much greater distances by avoiding enemy villages than was usual in New Guinea. The long climbs to the plateau, cold conditions, and lack of any source of supplies offset the value of the Kemabu Plateau sector, and the alternate valley route through Beoga has probably been of equal importance
in trade volume. Temple (1962) mentions meeting a party of
starving travellers about 20 km west of Ilaga, and he attrib-
utes human skeletons on the Kembu Plateau to death by expos-
ure. In 1972 the track was obviously still well used and worn
deeply into the ground in places, but the author's party met
no one.

A track of some importance from Beoga joins the east-west
route, and a few kilometers to the east, branches off to the
south-east to Amume-Damal areas at Jila and ultimately Akamuga.
This north-south route appeared much more travelled than the
minor track joining the Tsing Valley (and New Zealand Pass) to
the east-west track and Beoga track via Discovery Valley.
A branch may proceed east from the head of the Tsing Valley to
the Jila-Beoga track. The route from Ilaga to the Discovery
Valley-Tsiga track is of minor importance, although climbing
expeditions now utilise it quite frequently.

Other north-south routes are also not of major importance.
Tracks cross the range west of Mt. Leonard Darwin from the Aga
Valley to Demandora (R. Mitton, personal communication). Van
Nunen (1973) mentions the Dedematagapa Plateau further west
which is used by Moni as a route connecting Kugapa with settled
areas to the south such as Zando. The Bakopa Valley and Pass
form a well known route to Ertzberg and had been used by Western
Dani from Ilaga who were employed by the first glacier research
expedition in 1972. The track leads from the main east-west
track and meets another (followed by R. Mitton) which climbs
south-east from the Lower Kembu-Kemandoga Valley. At Bakopa
Pass the two tracks join for a short section and then fork again;
one probably leads down towards Atwanop to the south of Mt.
Idenburg, and the other continues south-east to reach the
Ertzberg, and then drops down a near precipice to the Aghawagon
River and Waa. This track was followed by Golijn (1937),

members of the 1973 glacier research expedition, and R. Mitton.
An east-west route apparently connects the Amume-Damal villages
at 1,400 - 1,700 meters along the southern side of the range,
apparently from at least Jila to the end of the range at
Waghete (Photo 1). The accounts of early explorers suggest
that access routes to the southern lowlands are almost non-
existent.

Bridge over the Aghawagon River near Waa

In addition to trade, the tracks cater for two current
trends in migration. Western Dani have been moving into the
Ilaga Valley in large numbers recently and even crossing the
Kembu Plateau to an isolated area in the Kemandoga Valley.
Damal are also moving south of the range, probably as a contin-
uation of the colonisation of this area by Amume-Damal
(Ellenberger, personal communication). A similar trend is apparent for the Moni (van Nunn, 1973).

The New Zealand Pass provides a new route from the Discovery Valley - Tsinga track to the Ertsberg. It was not generally known to people from Ilaga prior to 1971, although footprints that were found in the pass in late 1971 apparently belonged to casual workers from the mine returning to Beoga for Christmas. No track was present from the Ertsberg mine up to the pass until one was made by J. Peterson and J. Bennett in 1971. The pass has only been ice-free for about 20 years and thus cannot have been a traditional route. It is now used regularly by mine visitors and climbers, and is thus the highest track in New Guinea. A very indistinct track leads west from Lake Larson and this may represent the original route to the Bakopa Pass and then Ertsberg. Harrer (1964) went this way to Mt. Idenburg but mentions no tracks.

Fire and Hunting. The Kemabu Plateau tracks pass numerous huts. These are usually made with a framework of branches to give a pitched roof about 1.5 - 2 meters in height and 3 - 5 meters long. The roof is thatched with tree fern fronds, grass tussocks or sheets of the bark of the cypress Pauaecdorus bauana. The walls are about 1 meter in height and are often made from tree fern trunks and are sealed with grass and smaller branches. An A-frame construction is less common, with the more steeply pitched roof reaching the ground. One end is usually blocked by branches. Temple (1962) mentions many of these huts or kandangas (Western Dani), and several were encountered by the expedition. They are used by travellers but are probably built by hunting parties, who may stay for several days or revisit them from time to time. Temple (1962) states that parties from Ilaga travel to the plateau primarily in search of "ant eaters" (the long beaked echidna, Zaglossus bruijni) and a photograph taken at Ertsberg Mine in 1971 shows several of these animals being returned to Waan or Tsinga from the Bakopa Pass area. The range of animals sought is indicated in Table 2, derived from Hope (1976). It is unclear whether many of the hunted animals are returned to the villages. Carriers with the expedition took rodents caught in our metal traps, but made little effort to obtain game themselves.

In seeking the animals, and while travelling, fire is constantly in use and the present vegetation on the Kemabu Plateau has largely been determined by past firing (Photo 2).
However signs of recent grass fires were not common; one area of about 1 square kilometer near the east-west track and another near Lake Hogayaku showed signs of recent burning but most of the grasslands seen by both expeditions were mature and contained abundant fuel. However most of the slopes that must once have supported forest are now either grassland or occupied by tree ferns. The forest forms relict patches, particularly on ridge crests or on rocky karst hills. Past firing has mobilised or burnt the peaty soils and many of the grasslands occupy stony soils in which mushroom-shaped boulders perch, demonstrating the loss of up to 1 meter of acid peats.

By comparison with some other New Guinea mountains, notably Mt. Albert Edward (Paijmans and Loffler 1972), fire frequency is not high at present. This is reasonable, considering the isolation and relatively slight usage compared to mountain areas close to large populations. Brass (1941) records meeting several parties crossing over high passes near Mt. Trikora, the largest numbering 100. The vegetation there resembles that on the Kemabu Plateau but forests are still more restricted and Brass found many signs of recent burning. Mt. Giluwe, which is surrounded by heavily populated valleys within a few hours walk from high altitude areas, shows far greater evidence of human interference, with a network of minor tracks, almost complete deforestation above 3,500 meters, and snares laid for rodents dotting the grasslands.

The climate, topography, and population density to the south does not favor fire, and accordingly the vegetation shows little sign of interference. The degree of forest clearance and soil loss on the Kemabu Plateau however, argues for a very long history of disturbance at present levels. This is discussed later in relation to the archaeological sites.

**Cultural Change.** Traditional usage of Mt. Jaya is affected by mining and by climbing parties. The Ertsberg mine of the Freeport Indonesia Company lies at 3600 meters on the southern face of Mt. Jaya at the headwaters of the Aghawagon River. The traditional route from Bakopa pass to Waa village has been disrupted where it descends the cliffs directly below the mine. However the road which starts at the base of the cliff provides much better access than formerly to the lower mountain areas and indeed the coast.

In its imposition of a highly technological enterprise onto a partly uncontacted region the mining operation represents one of the most extreme examples of cultural change that has occurred in the world. The mission areas to the north have introduced modern technology on a much more modest scale, and the introduction has specifically accompanied education and explanation for the local people. The mine was imposed abruptly and with a direct policy of avoiding interaction with the Amune-Damal. As described by Adams (1973), over a period of only three years the mine built the longest road in Irian Jaya, including two tunnels, by utilising massive earthmoving equipment, trucks, large helicopters and huge amounts of explosives. To do this several hundred Europeans and Indonesians were brought in and supported in camps that had electricity, refrigeration, heating, and a wide array of entirely imported foodstuffs. As with any large project in which logistics are a problem a relatively high wastage rate in food and materials is budgeted for, with replacement rather than repair being economically justified for most equipment. The result of this is that the mining operation particularly in its establishment stages, produced quite staggering quantities of refuse or unwanted materials which were generally simply moved out of the way and abandoned. To a society that values even a tin can as a superior container, the appearance of apparently inexhaustible supplies of metal, cloth
and even food around the camps must have come as a shock. No reliable record of the effects of this on the local population seems to have been made. However a better factual basis for supporting the concept of a cargo cult must be hard to imagine.

Millennial movements are not unknown among the Amume-Damal. John Ellenberger (personal communication) encountered one in which a person claimed to be a messiah and convinced a village group to stop the cultivation of crops in the expectation that unceasing riches would be provided if a key could be found to unlock a stone on the mountain. Two incidents suggest that the mine might be reinforcing similar concepts among its neighbors: in 1971 helicopter pilots reported that villages in the Atwanop (West Otomona) area had built copies of the helicopter pads; and in 1974 R. Mitton found a large marquee (55 kg) erected but unused in Urimba, which must have been carried for at least three days' walk from the Ertseberg. Unfortunately I have no up to date information to indicate whether these effects are continuing or not. The possibility of obtaining work and valuable abandoned articles has drawn men from Moni, Damal and Western Dani areas, and many of these now routinely cross over New Zealand Pass laden down with goods to take back to the villages. Presumably this new trade also operates among the southern Amume-Damal.

The rather numerous climbing parties of the last few years have nearly all gained access from Ilaga. The daily rate for carrying (ca. Rp. 500 = US$1.20) is high particularly since there is almost no other method of obtaining a cash income. Besides having a possible effect on the local economy, many of the carriers are visiting the plateau area and New Zealand Pass for the first time. This probably reinforces the number of men visiting Ertseberg but may also increase hunting activity by Western Dani in this area.

B. MAN IN THE PAST

The study of the prehistory of Irian Jaya lags behind other provinces in Indonesia and work carried out in Papua New Guinea. This is despite the key place Irian Jaya commands in many theories of the settlement of the Australian region, later migrations and the development of the remarkable agricultural systems of the central ranges. The situation certainly does not arise from the absence of suitable sites. Even on Mt. Jaya, remote from permanent settlement, evidence for former occupation was abundant.

Several rock shelters on the Kemabu Plateau have been utilised by earlier expeditions (Temple 1962; Harrer 1964; Hamid et al 1964). The two glacier research expeditions also camped in such shelters on several occasions and noted abundant signs of long-term human occupation in all, such as thick smoke stains on walls and roofs, and widespread ash. In the absence of a trained archaeologist and without permission from the Indonesian Archeological Institute (LPPN) no systematic excavations could be attempted. However modifications to rock shelters by climbing parties had exposed floor sections in two cases, and during the first expedition samples were salvaged to prevent total loss.

Mapala Rock Shelter. This site is located about 1.2 km north of Ngga Pulu near the south-western side of Lake Larson at 3,996 meters (Photo 3). The first expedition of the Mapala Club of the University of Indonesia in February 1972 was directed to the shelter by their Damal guides and used it as a base camp, as have most climbing parties since. The shelter is formed by a large block of limestone (15 x 15 x 8 m) perched by retreating ice on two small lateral moraine ridges. An overhang of about 2 meters on the southern side of the block provides an outer exposed but dry apron along the base. Near the south-west corner
firewood is available. Water can be obtained from a drip-fed soak on the eastern side of the block or from the lake. Heavy frosts and light snow were common in February 1972.

The Mapala party camped in the rock shelter and under the overhang, and discovered the archaeological deposit when they dug out the floor to make more headroom. They also levelled the ground under the overhang but found no noticeable traces of occupation deposit there. The author visited the Mapala camp and collected bulk bone samples from the excavation spoil, and charcoal and a few bones from the face of the exposed section inside the rock shelter.
Three distinct occupation layers were exposed in the deposit (Photo 4). The topmost 5 cm consisted of fine red-grey ash, with no bone or charcoal. Beneath this was about 27 cm of a very black deposit, rich in bone, charcoal and carbonized twigs. The lowest layer consisted of about 10 cm of grey clayey silts with scattered bones and small fragments of charcoal. This horizon graded into a sterile grey silty clay containing pebbles which is presumably the basal limestone till. Charcoal fragments were collected from a 10 cm x 10 cm area in the grey silts 2-5 cm below the distinct boundary with the rich central deposit:

ANU - 1015 5,440 ± 130 BP Charcoal 34-39 cm

No systematic search was made for artefactual material since it was considered best to leave the remainder of the deposit untouched for future study. However a large sample of bone was recovered from the part of the deposit dug out by the Mapala party. On sorting the latter, two pieces of stone of possible human origin were found and are now lodged with the Department of Prehistory, Australian National University. One is a piece of chert about 15 x 20 mm in size; the other a piece of granodiorite resembling the rock that forms the Grasberg, about 4 km southwest across the Northwall. Mr. R.J. Lampert, Department of Prehistory, Australian National University, examined the specimens and notes:

The chert flake, which has broken away from the working edge of an implement, shows characteristics noted by White (1972) for many chert scrapers found in the eastern-central highlands. Typical of such scrapers, the specimen from Mapala has a working edge that is steeply, heavily step flaked and overhung. Whether the piece of granodiorite formed part of an artefact is not entirely certain, although clearly it must have been transported to the site through human agency. One surface is distinctly smooth, but examination through a binocular microscope failed to reveal the striations typical of a deliberate grinding and polishing. Its other surfaces were formed by fracture, but there is no sign of intentional flaking.

Three pieces of mollusc shell were found, and one, an almost complete valve, was large enough to be identified by Dr. P. Colman, Australian Museum, as an indeterminate species of the family Geloinidae. This family is restricted to brackish coastal waters, but some species, which are used as ornaments in the Papua New Guinea Highlands, have been found in archaeological sites there (White 1972). The shell fragments, which were from the middle layer of the Mapala deposit must have been brought originally from the coast.

The main component of the collection was mammal bone identified by J.H. Hope and this is listed in Table 2. The small amount of bone associated with the radiocarbon dated horizon included the copper ringtail possum, bandicoot, and wallaby. In the bone-rich horizon the presence of bones of the long-beaked echidna shows that this species was consumed on the site. This is of interest in that the apparent aim of at least some present hunting expeditions appears to be to return this species to the settled areas.

Another contrast arises from the relatively frequent occurrence of two species of wallaby in the bone material. Damal and Western Dani who were asked about the extent fauna of the area did not seem to know of wallabies in the area, and identified pictures of another montane species (Porcospinus vanheurni) as the coastal wallaby. The possibility exists that these species have become rare or even extinct within the past 5,000 years. The establishment of a wild dog population could have contributed to this situation more than direct hunting pressure.

Damal guides from Beoga who located the rock shelter for the Mapala party commented that their grandfathers used to camp
Table 2: Mammals Probably Hunted on Mt. Jaya

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Modern observed or coll.</th>
<th>Hamid r.s.</th>
<th>Mapala r.s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaglossus bruijni</td>
<td>Long-beaked echidna</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Sattailus albopunctatus</td>
<td>Marsupial cat</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peroryctes longisunda</td>
<td>Bandicoot</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudocheirus cupreus</td>
<td>Copper ringtail possum</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. mayeri</td>
<td>Pygmy ringtail possum</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phalanger sp</td>
<td>Mountain cuscus</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thylogale bruijni</td>
<td>Wallaby</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. sp. nov.</td>
<td>Wallaby</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dendrolagus dorianus</td>
<td>Tricolored tree kangaroo</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallomys rothschildi</td>
<td>Smooth-tailed giant rat</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Hyomys goliath</td>
<td>Rough-tailed giant rat</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Rattus richardsoni</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. niobe</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canis familiaris</td>
<td>Dog</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Bone-free. This level may represent the most recent cultural horizon and one which is distinct from the bone-rich horizon.

Leth. Kol. Haji Aswar Hamid Rock Shelter. This rock shelter is located at 3,450 meters about 15 km north-east of the Northwall and 500 km south of the Kembu River on a ridge to the west of the tributary leaving Lake Hogyaku. It appears to be currently used considerably more than is the Mapala rock shelter. The Beoga-Tsina track leads past it and several tracks criss-cross the general area (Photo 2). The shelter consists of an under cut about 20 meters in length and 1-2 meters in depth and height lying at the base of the northern wall of the doline (Photo 5), about 100 meters across and 25 meters deep. A short tunnel...
Indirect Evidence from Vegetation History. Man's effect on the vegetation provides an indirect measure of his presence and level of activity. The technique used is to collect complete sections of organic sediments which have built up in swamps or lakes over thousands of years. Samples from the sections are examined microscopically for pollen grains and minute particles of carbonised plant matter, from which the nature of the vegetation and the role of fire in it can be reconstructed to provide a continuous record over the history of the deposit. The sediments can be dated directly by radiocarbon and if a steady rate of accumulation has occurred, then the age of any change in the vegetation can be rather precisely calculated. The record obtained has advantages and disadvantages compared to the usual archaeological method of excavating in rock shelters or open sites; it integrates changes over a large area at least several hundred metres across and the swamp sediments themselves are usually independent of human activity. Accordingly it can provide a complete history both preceding and postdating occupation, whereas midden accumulation may be episodic, with large lapses of time not represented in any way. However vegetation changes are often due to non-anthropogenic causes such as climate change, or natural development. Also low levels of human activity may not affect the vegetation sufficiently to be recorded.

Carbonised particle frequencies provide only a very rough indication of regional fire frequency, and the fires may have had natural causes. However in the perennially wet cool central ranges of Irian Jaya man is the likeliest cause of extensive burning. Large variations in the carbonised particle frequencies probably reflect change in the fire regime which corresponds to a change in the intensity of visits by hunters or travellers; in most subalpine areas in New Guinea at present grass fires are lit casually while passing for the pleasure of
seeing the burn. These fires help maintain the grassland but usually cause no harm to the humid forest edge except after extreme dry weather. Under high fire frequencies the forest edge will retreat; most of the open slopes on the Kemabu Plateau are the result of forest destruction by fire, probably initiated along tracks through naturally open areas such as mires or stream banks. Fire and frost tolerant shrubs and tree ferns invade the grassland if very frequent burning is not maintained. Soil loss may be so extensive as to hinder recolonisation by forest (photo 6). Even in the absence of fires this is probably very slow. Thus the present open nature of the Kemabu Plateau may not necessarily reflect current burning rates. Indeed the very widespread groves of ferns with tall shrubs suggest that the vegetation has been returning to a wooden state for a considerable time.

A 10-meter core of sediments was recovered from Ijomba Bog at 3,630 meters altitude in Discovery Valley on the Kemabu Plateau. The site is about 4 km north of the Mapala rock shelter and the track between the Homid and the Mapala shelters runs along the western side of Discovery Valley. The vegetation on the slopes away from the mire is disturbed, consisting mainly of grassland with scattered tree ferns and low shrubs. Forest occurs on the crest of the valley walls, which are formed by large moraines related to the last maximum glaciation.

Details of the site are given by Hope et al. (1976). The sediments accumulated after ice withdrew and blocked the valley with a moraine which impounded a lake. The lake was present from before 14,500 years ago until about 9,500 BP (based on two radiocarbon dates). It then dried up and no record exists until 6,500 BP (also dated) when bog sediments began to accumulate, building up about 3 meters of peat until the present. Pollen analysis showed that alpine communities near the bog were replaced by subalpine shrublands at about 13,500 BP. The subalpine forest similar to the present day was established by about 10,000 BP. This development probably reflects a climatic warming to levels around those of the present. The forest could be expected to have continued to surround the site completely for the last 11,500 years, except where the ground was very wet. Instead, at about 10,300 BP, the forest opened out enough to allow an increase in tree ferns to approximately present levels. This event cannot be definitely ascribed to disturbance, because tree ferns could have been excluded from Discovery Valley before this by cold. However the carbonised particle curve rises from a very low level to one exceeding those of the present day around 11,000 years ago, and remains at high levels until the end of the lake phase.

At the start of the bog phase, that is at 6,500 BP, carbonised
particle frequencies remain high, and the pollen diagram shows that considerable forest degradation had already occurred. Between 5000 and 1500 BP, more opening out and reduction in forest elements took place. Tree ferns remain important, but fluctuate with peaks before 5,500 BP, at 3,900 BP, and 1,300 BP. The carbonised particles indicate very high fire frequencies between 4,000 and 2,000 BP, declining thereafter to the present low level. Taken together, this indicates a continuing disturbance of the forest in Discovery Valley which was initiated before 6,500 BP, possibly as early as 11,000 BP, but which was especially intense between 5,000 and 2,000 years ago.

Discussion. The deposits reported here are the first dated archaeological records for very high altitude in New Guinea. They show that man has been a visitor in the area for at least the past 5,000 years, and may have penetrated to high altitudes well before this. A glottochronological time depth measurement of Ekagi and Moni languages (Larson and Larson 1972) suggests that these languages have developed from a common base over about 3,000 years. It can be assumed that the early hunters who camped in the Mapala rock shelter were quite distinct in language and culture from the present Damba.

The existence of hunting activity from these early times suggests that a settled population was already established at lower altitudes. Certainly the presence of coastal shell at Mapala demonstrates the existence of a trading network. The shell was found in a bone-rich horizon indicating a phase of rather intense occupation. Although this phase has not been directly dated, it may coincide with the peak in firing at Ijomba between 4,000 and 2,000 BP. It is possible to speculate that this phase presents an initial exploitation of abundant game, and that hunting may be less productive now, at least in terms of wallaby and echidna. Equally changes at lower altitudes in the form of new crop plants or agricultural methods may have reduced the importance of the high country as a resource area. Nothing is known of current hunting success rates, and comprehensive excavations of the Hamid, Mapala and other shelters on the Kemabu Plateau are needed to establish times of initial occupation and period of major utilisation. This would demonstrate any patterns in the utilisation history, perhaps from the treeline at earliest times down onto the plateau as forest became cleared, or following forest clearance up to higher altitudes.

Similar evidence of disturbance is available from other New Guinea mountains. Deposits of charcoal from wood fires at 3,500 meters altitude have been dated on the Saruwaged Mountains and Mt. Giliwe, at 3,800-4,300 years BP. If this charcoal is attributed to man-made fires, then disturbance of the subalpine forest had commenced by this time (Hope and Hope 1976). On Mt. Wilhelm, Hope (1976) records clearance of subalpine forest after 1,000 years BP and links it with agricultural expansion at lower altitudes. On Mt. Albert Edward, the subalpine forest appears to have been disturbed throughout the last 12,000 years, even since conditions became suitable for its growth (Hope, unpublished data). Only a few kilometers from this site there are records of human occupation extending back from 7,000 BP to 27,000 BP, the earliest date for occupation in the island (White et al. 1970) (Hope, unpublished data).

Widespread agriculture dates to before 6,500 BP in eastern New Guinea, but there appears to be no definite relationship between it and the varied exploitation histories of high altitude areas. Hope and Hope (1976) have pointed out that prior to 10-12,000 years ago the mountain grasslands extended to much lower limits, and had an area of perhaps 50,000 sq. km. The first people to reach New Guinea, presumably from Indonesia, may have first occupied the coast, but had certainly reached
the highlands by about 30,000 years ago. They would then have had access to the subalpine grasslands for hunting and swifter travel than was possible in the forested areas. However no high altitude archaeological sites are known which date back to glacial times. If the subalpine areas were visited the usage of the plateau for hunting and access tracks would have evolved naturally after forest choked the lower valleys with the rise in the treeline.

CONCLUSIONS.

The observations made during the short period of the expeditions point to the need for more comprehensive research, both in the effects of development on traditional usage of the mountains and on the prehistory of that usage. The results from the Ijomba site show that montaine Irian Jaya is particularly suited for the application of the technique of vegetation history to prehistory, although archaeology by conventional methods is as urgently required. It appears that the high altitude country is not presently a vital resource to the local inhabitants. The Mt. Jaya area has considerable potential for tourism, and the subalpine areas at least should be relatively well adapted to tolerate disturbance, given its long history.

ACKNOWLEDGEMENTS.

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References.


