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APPLIED ANTHROPOLOGY

**SOCIAL IMPACT OF THE OK TEDI MINE
ON THE YONGGOM VILLAGES OF
THE NORTH FLY, 1992**

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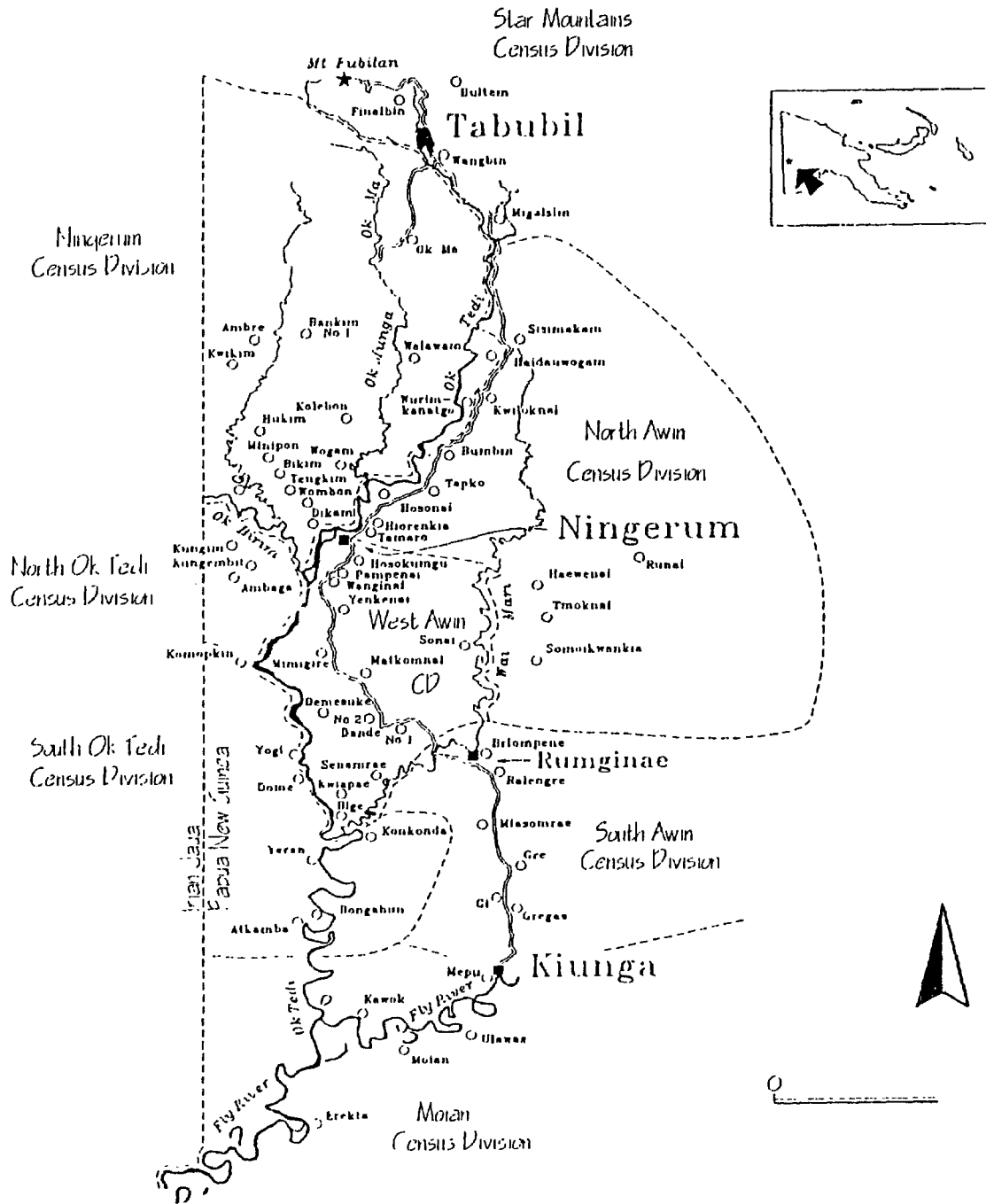
This article is a revised version of a report originally written for Unisearch PNG Pty Ltd, under contract to Ok Tedi Mining Limited (OTML), which appeared as Volume #5 in a series of reports produced as part of the Ok-Fly Social Monitoring Programme. The fieldwork for this study was undertaken over a period of three weeks in July-August 1992. The author had previously spent nearly two years at Dome village, from 1987 to 1989, doing research for his doctoral thesis (see Kirsch 1989, 1991). By 1992, it was already known that this area had suffered more extensive environmental damage as a result of the operations of the Ok Tedi mine than any of the other areas downstream of the mine. When Kirsch's report was presented to the mining company in July 1993, the extent of this damage, and the nature of local people's reaction to it, was made abundantly clear. Subsequent events have served to underline the prescience of his analysis and recommendations.

SCOPE AND METHODS

Scope of Inquiries

This report evaluates the social, cultural and environmental impact of change in the three Yonggom-speaking census divisions of Western Province (Figure 1). It is felt that the report would be of limited benefit were it only to address issues or problems directly related to the presence of the Ok Tedi mine. The complex social, cultural and environmental consequences of the mine's activities cannot be easily or accurately disengaged from other on-going processes. The report is therefore intended to provide a broad overview of current circumstances in these areas, to identify problems and suggest remedies.

Figure 1: Location map — villages, zones and census divisions.



My Treatment of the Key Issue: Tailings Disposal

The foremost issue in the minds of the people living in the study area is tailings disposal. As I will make clear below, *all* the Yonggom people I interviewed were aggrieved at the level of damage to their environment caused by the dumping of waste rock and ore process wastes into the upper Ok Tedi River. While a few of their villages are situated inland and away from the river, and others are located on the Fly River upstream of the D'Albertis Junction, for the most part Yonggom villages are in daily contact with the river, which now carries a greatly exaggerated sediment load. Flooding has caused this sediment to be carried over the banks of the river, producing extensive die-back in the adjoining forests. Since 1988, villages along the river have suffered absolute loss of tracts of land amounting to hundreds of hectares, including formerly valuable garden land in the river's flood plain. Riverine wildlife, including birds, fish, and turtles, have been adversely affected as well. A question that I can raise, but must leave for others to answer, is whether such environmental impacts can ever be appropriately compensated with money or other resources.

It is reasonable to assume that cash compensation is a satisfactory solution to 'small' and incidental damages occasioned as part of the agreed project plan, even if the amounts paid add up to a considerable sum over a period of time. Of course, compensation for garden and forest damage is an OTML policy (Ok Tedi Mining Limited 1992a:i) and would be seen locally as partial mitigation for losses, although none had actually been paid in the study area at the time of this research. But it would be a mistake to extend a programme of piecemeal cash compensation to 'major' damage not foreshadowed by the project plan, especially without a great deal of further discussion with representatives of the affected areas. I sincerely hope that this consultation occurs.

If what villagers are saying is not being clearly heard at the distance of Tabubil, Kiunga, Daru or Port Moresby, my report systematically reviews their responses, village by village, to my questions about the impact of the mine on their land and resources. The purpose of presenting my findings in this format is to create a permanent record of local opinion in the study area. Direct and accurate representation of village perspectives is an essential precondition for future planning in the area. My presentation of these views and opinions does not necessarily imply that I endorse them as entirely accurate. I attempt an interpretation in the concluding section.

Ethical Concerns

As a practicing anthropologist, I am bound to consider the ethical issues associated with doing applied research among a people with whom my relationship was established for quite different reasons. Earlier, as a research student, I enjoyed the mutual trust that exists between hosts and guest. My re-entry into the community was thus underwritten by this relationship of trust, and by my ability to speak the Yonggom language. I took every available opportunity to make it clear to villagers that although I was employed by

Unisearch, the research was sponsored by OTML. It is my intention to honour the guidelines on ethics that have been set forth in 'Principles of Professional Responsibility,' adopted by the Council of the American Anthropological Association (AAA) in May 1971:

In research, an anthropologist's paramount responsibility is to those he studies. When there is a conflict of interest, these individuals must come first. The anthropologist must do everything within his power to protect their physical, social and psychological welfare and to honour their dignity and privacy....

The AAA further indicates that 'no reports should be provided to sponsors that are not also available to the general public and where practicable, to the population studied'.

I have a contractual duty to my client but, with care, I do not see that this need come into conflict with my professional obligations. I intend to write for a general audience and the report will be submitted, in due course, for publication.¹ Most pertinently, I will *not* include in my report comments or information that will not bear public scrutiny. This is consistent with the major recommendation of the report, which is that it is imperative to improve communication between OTML and the people of Western Province. This report presents information about the social impact of the Ok Tedi mine and the views of the people living in its impact area. As such, its eventual publication is intended to contribute to this process of communication.

Questions and Outcomes

One way to approach this project is to examine the potential for cooperation among two groups whose interests might otherwise be opposed. The interests of the company are to continue to run a profitable mine at Mount Fubilan for the duration of the ore body, which is currently estimated at about eighteen years (until 2011), and to continue to provide jobs for its employees. The people of Western Province, for the most part, also want the mine to stay in operation because of the benefits that it brings to the region, both directly and indirectly, including improved infrastructure and transportation, employment opportunities, and dramatically enhanced revenues. Additional benefits come from projects supported by the Ok Tedi-Fly River Development Trust (the Trust) and annual cash payments from the Village Development Fund (VDF). The Trust was set up by OTML in 1989 to contribute to infrastructure projects and to assist in the development of the approximately 100 villages identified as being on, or having land abutting, the Ok Tedi and Fly River systems. The VDF comprises grants of money made as part of the Trust budget to each person recorded by annual census as living in a Trust village.

One goal of this document is to identify areas in which the interests of the two groups overlap. OTML will obviously cease operating the mine if its costs

¹ This is the publication.

become too high, although it is impossible for an outsider to calculate this limit. Could OTML engineer an alternative tailings disposal scheme tomorrow and still make a profit? Given suitable technical means, probably. Could they do this, increase wages and improve working conditions, increase benefits to impacted areas and make back-dated compensation payments to people living along the river system? The answer is less clear. Furthermore, given recent events in Bougainville, any financial decision that the mine may make is strongly influenced by the recognition that there are no guarantees that they will be able to continue their operations indefinitely. In other words, it is not only the *cost* of new tailings disposal facilities that concerns the company, but the likelihood that they will be able to stay in operation long enough to recoup any additional investment.

The current consensus of the parties I concern myself with here — OTML and the people of Western Province — is that the mine should continue to operate. The question thus becomes: what are the circumstances necessary to maintain this consensus?

The Study Area

The study area includes eighteen villages from the North Ok Tedi, South Ok Tedi and Moian Census Divisions in Western Province, Papua New Guinea, with a total population of 5987 in 1990 (National Statistical Office 1991). All but three of these villages are inhabited by people known as the Yonggom, so that recent Trust village enumerations suggest that about 4649 Yonggom live permanently in Papua New Guinea (King 1993, Table A; cf. Kirsch 1991:2). The Yonggom are part of a much larger cultural-linguistic group which extends westward across the border into Irian Jaya, Indonesia, where they are known as the Muyu. The combined population of the two groups is more than 15,000 persons (Kirsch 1991:2). Primary anthropological research has been carried out among the Yonggom in Papua New Guinea by myself (Kirsch 1991) and among their western neighbours by Schoorl (1957). Roughly five thousand of the refugees from Irian Jaya that came into Papua New Guinea during the border crossing of 1984 are Muyu (Kirsch 1989).

Local Government

The Yonggom villages are split between the Ningerum and Kiunga Local Government Councils; the current list of councillors is given in Table 1. Note that in the Ningerum and Kiunga Councils, the Yonggom wards make up two of the total of 24, and nine of the total of 25 wards, respectively. The other wards are those of Ningerum and Awin (Ackyom) speakers.

Table 1: List of village councillors in the study area and number of tax payers.

Ningerum Local Government Council		
<i>Village</i>	<i>Councillor</i>	<i>Approx. no. of adults*</i>
Ambaga	Kurem KARUNG	94
Birimkamba	Kurem KARUNG	13
Kungim	Karolus KITOM	165
Kungembit	Karolus KITOM	59
Kiunga Local Government Council, Ok Tedi-Moian constituency		
<i>Village</i>	<i>Councillor</i>	<i>Approx. no. of adults*</i>
Membok	Vincent VENIP	170
Karemgu	Vincent VENIP	184
Erekta	Gaitanus ANGEN [†]	194
Kawok	Aloisus BONDIT	142
Moian	Aloisus BONDIT	274
Ulawas	Kawing KANEMPUT	230
Atkamba	Atuk ANGYA	322
Komokpin	Thomas KANEM	229
Dome	Kati YANGKAP	248
Bongabun	Papa IMEN	35
Konkonda	Papa IMEN	363
Yogi	Thomas KANEM	166
Yeran	Thomas KANEM	83
Kukujaba	Kaspar KAMETA	111

* Tax payers counted by the councils, 1990-91.

[†] Kiunga Council Vice-President.

Source: Ningerum and Kiunga Local Government Council offices (courtesy of J. Burton).

Population Counts

I have examined the census figures recently obtained by both the National Statistical Office and the Trust's field officers (reproduced in King 1993) and I have concerns about their accuracy. First, the NSO figures may be dismissed because they make no separation between refugees and *bona fide* villagers along the border. The Trust census for Dome, the village I know best, seems too high at 423 in 1991. The 1980 figure of 204 I believe to have been approximately correct. A June 1988 headcount taken in Dome by a village health care worker produced a figure of 180 persons (Kirsch 1991:61). Table 1 shows the figure of 242 adults for Dome, a count made by the Kiunga Council for tax purposes. The gap in these figures seems to reflect different assumptions about what constitutes an accurate census. From the Yonggom point of view, people living in Kiunga retain their status as village members even though they may have lived in town for many years. It is not clear what criteria for residence are being applied in each case. The figures for Yogi and Kamokpin reflect this problem as well. The

case of Birimkaba is also puzzling; I was unaware that anyone still regarded Birimkaba as their primary place of residence until I saw the OMTL census figures. The people come under the Ambaga councillor, and the Ningerum Council only placed 13 adults there in 1991. The Trust enumerated 211 people in the same year. This problem should be straightened out.

Breakdown into Zones

For the purposes of this study, I have divided the study area into four zones comprising groups of villages sharing similar economic and geographic circumstances and a similar level of environmental impact from the mine (Figure 1).

- **Zone 1** extends down the Fly from Kiunga to the confluence with the Ok Tedi (the D'Albertis Junction). It includes three villages along the Fly River and its tributaries: Ulawas, Moian and Kawok.
- **Zone 2** extends south along the Fly River from the D'Albertis Junction to the Binge River. It includes one village (Erekta) along the Fly and three villages (Karemgu, Membok and Kukujaba) on the Binge.
- **Zone 3** comprises the North Ok Tedi Census Division and is bounded by the Ok Tedi, Ok Birim and Ok Kamen Rivers. It includes three villages: Kungim, Kungembit and Ambaga.
- **Zone 4** comprises the South Ok Tedi Census Division. It includes six Yonggom villages: Komokpin, Yogi, Dome, Yeran, Bongabun and Atkamba. The Awin village of Konkonda, on the east bank of the Ok Tedi, is also in this Census Division, but Bige, also Awin-speaking, is in West Awin Census Division. I have included Bige in my study, because it is the only Awin village sited directly on the Ok Tedi and because its villagers have hunting rights on the Yonggom side of the river near Dome.²

Methods

Fieldwork took place over a period of 21 days, from 25 July to 15 August 1992, and included visits to all but one of the seventeen Trust villages in the region. I was able to interview members of the last village, and also collected data from Kungim village, which was not included in the trust at the time of study.

For each village, I followed a directed interview schedule to collect social, economic and historical information, including clan and lineage membership and patterns of land ownership. The basic data are summarised in Table 2. The second half of each interview was reserved for undirected discussion of the

² The Yonggom currently have use rights on the Awin side of the river in several places, including the land opposite Yeran. In his 1923 patrol report, Leo Austen indicated that the Yonggom had use rights to the land opposite Komokpin as well.

villagers' perceptions of the social, cultural and environmental impact of the Ok Tedi mine.

Table 2: Villages in the study area with summary data on aspects of social development and economic activity.

Village	1991 pop.	Gr. 10 leavers	Principal facilities	Water supply	Vill. radio	Trade stores	Iron rf. houses
Kawok	116	6	—	2 tanks	—	1	3
Moian	420	10	school, aid post	4 tanks	yes	5	7
Ulawas	302	10	—	5 tanks	—	—	5
Erekta	289	7	—	3 tanks	—	1	—
Karemgu	586	5	—	1 tank	—	n.a.	4
Membok	413	10	school, aid post	no data	yes	n.a.	5
Kukujaba	177	—	—	1 tank	—	n.a.	—
Ambaga	327	16	school	2 tanks	—	—	—
Kungembit	155	10	aid post	2 tanks	—	1	2
Kungim	2200	20	school, mission	6 tanks	yes	4	—
Atkamba	510	37	school, health SC	6 tanks	yes	5	11
Bongabun	56	n.a.	—	1 tank	—	—	1
Dome	423	20	school, aid post	3 tanks	yes	5	1
Yeran	108	3	—	3 tanks	—	1	1
Yogi	222	11	—	2 tanks	—	3	1
Komopkin	334	11	school, aid post	2 tanks	—	2	1
Konkonda	n.a.	n.a.	—	no data	—	—	no data

Table 2 (continued).

Village	Church memb'ship	Refugees nearby	Village endogamy	Rubber production	Goods to market	Motor canoes
Kawok	all Catholic	no	71%	not tapping	yes	6
Moian	all Catholic	no	40%	not tapping	yes	8
Ulawas	all Catholic	no	67%	not tapping	yes	10
Erekta	all Catholic	yes	90%	not tapping	—	8
Karemgu	all Catholic	yes	no data	not tapping	—	no data
Membok	all Catholic	yes	40%	not tapping	—	10
Kukujaba	all Catholic	yes	no data	not tapping	yes	1
Ambaga	mixed	no	90%	no trees	—	inland
Kungembit	all Catholic	previously	60%	no trees	yes	inland
Kungim	all Catholic	yes	100%	no trees	—	inland
Atkamba	all ECP	previously	80%	not tapping	—	12
Bongabun	all ECP	previously	no data	not tapping	—	1
Dome	mixed	yes	80%	tapping rare	—	4
Yeran	all ECP	previously	50%	not tapping	—	1
Yogi	all ECP	yes	30%	not tapping	—	5
Komopkin	mixed	previously	80%	no trees	—	4
Konkonda	all ECP	no	no data	not tapping	—	1

I was also able to collect information in other ways. With Ian Wood, of OTML's Environment Department, and my colleague John Burton, I visited river bank sites by helicopter on the lower Ok Tedi at Dome, Bige and on the meander south of Bige, where the impact of sedimentation on gardens and forests has been the greatest. In addition, I interviewed members of a variety of governmental and non-governmental organisations, many of whom I acknowledge below.

Acknowledgments

Fieldwork was carried out with the assistance of Buka Nandun from Dome village, who served as research assistant for this project, and also Atani Wungmo. Both deserve my gratitude. I am also grateful to the villagers who agreed to discuss their problems and concerns with me, despite their apprehension about speaking openly about many of these issues. I hope that this report does justice to their point of view.

I had very useful conversations with Isadore Kaseng, Premier of Western Province; Rex Dagi, organiser of ENECO PNG, an environmental organisation; Alex Maun, member of the Ok Tedi Landowners Association; Pastor Kirine Yuandit of the Evangelical Church of Papua in Kiunga; Hohore Kerekere of the Department of Primary Industry in Kiunga; Niko Bun, a teacher at Kiunga High School; Dave Matthews (regarding the proposed North Fly rubber project); Don Cooper, Area Supervisor at Kiunga Wharf; Steve Christensen of the Summer Institute of Linguistics, based at Yogi village; Mathieus Korodi, Committee Member at Dome Border Camp; Bishop Gerard Deschamps of the Montfort Catholic Mission at Kiunga;³ Dr. Mark Fitzmaurice at Rumginae Hospital; and Dr. Paul Spicer of the OTML Medical Department.

I thank Murray Eagle, Martin Paining and Ian Wood of OTML for assistance with my study. The facilities of the Environment Department at OTML were placed at my disposal during the final week of fieldwork and every assistance was rendered by its staff members; again I thank Andy Markham, Ian Wood and Rose for their assistance. Martin Paining and Jeff Ransley, of OTML's Community Relations Department, provided valuable commentary on their extension work. I also wish to thank John Burton and Colin Filer for their assistance in production of the original report and in the process of revising it for publication.

³ Where I quote refugee numbers in border camps, other than at villages which I visited myself, they are those provided to me by Bishop Deschamps.

ZONE 1: THE FLY RIVER BETWEEN KIUNGA AND THE OK TEDI

Overview

There are three Yonggom villages located along the Fly River between the town of Kiunga and the junction of the Fly River and the Ok Tedi: Kawok, Moian and Ulawas (see Figure 1). They all show signs of relative prosperity. The number of permanent houses with iron roofs and canoes with outboard motors (Table 2) indicates a reasonable cash flow. Motor canoes travel with regularity from all three villages to Kiunga, where people sell garden and forest produce at the market.

Kawok, Moian and Ulawas have all acquired the air of 'suburban' villages. They make regular use of resources in Kiunga, including the market, health care, schools and occasional wage labour, while maintaining their subsistence and residential base in the village. There are even people who work in Kiunga during the week and commute to their villages on most weekends.⁴ From the Yonggom point of view, these developments are largely positive. It provides them with what most would consider to be nearly ideal circumstances: village life with regular access to resources and opportunities in town.

The major need of these villages is to develop alternative sources of cash income so that villagers can maintain their independence without having to seek full-time employment in town. Given the low cost of transport between these villages and the Kiunga market, the villages are well suited for small-scale development projects that would produce goods for sale in town.

The most significant problem in Zone 1, however, is the concern that local people have regarding the impact of OTML's operations at Kiunga wharf on their environment, particularly downstream along the Fly. Most people in the three villages no longer make use of resources from the Fly River, including fish and other aquatic life, river bank garden land and river bank sago stands. In addition, the villagers no longer sell fish and turtles at Kiunga market, largely because the people in town will not buy riverine produce from this stretch of the Fly River because of concerns about OTML operations. The environmental impact of Kiunga wharf operations, therefore, should be independently evaluated, with the results made accessible to the villagers living in Zone 1 as well as the people living in Kiunga and the adjacent corners.

Kawok Village

Kawok village (1980 population, 54; latest count, 116⁴) used to be located further east along the Fly River, much closer to Kiunga. The villagers moved in 1961 because 'too many people were dying'. At that time, no one was living in

⁴ In village descriptions, 'latest count' will refer to OTML's 1991 enumeration (King 1993, Table A).

the area of the current settlement or at the junction of the Ok Tedi and Fly Rivers, even though there had been settlements there in the past.⁵

The land on which the village is built is owned by members of two lineages. The other villagers belong to eleven different lineages, with land rights elsewhere. As in most Yonggom villages, land ownership is dispersed over a very wide area, and a percentage of villagers must regularly use land that does not belong to them. In other words, land ownership and village residence do not necessarily correspond. Patterns of land ownership for Kawok village are shown in Table 3.

Table 3: Distribution of land holdings for clan members resident at Kawok.

Clan	Land
Imitman	Current site of Kawok village
Wimgo	Current site of Kawok village
Ninibirán	Northwest of Dome village, along the border; land runs along Ok Nini creek, a western tributary of the Ok Tedi
Wambiran	West of Bongabun village, between Ok Tedi & the border
Miripki-Aruawap	At the Junction of Ok Tedi & Fly Rivers, known as Derikaba
Kawok	At the junction of Ok Tedi & Fly Rivers; lends its name to the village
Yat	Northwest of Dome village, on both sides of the border
Apai	Previous village site along Wai Nam creek, closer to Kiunga
Kawubu	Previous village site (see above)
Anombiran	Northwest of Dome Village, near Ok Nini creek (see above)
Dimin-Kuk-Yuran	West of Yogi village
Kawang-Kibian	A Yonggom man from Irian Jaya settled in Nago, at Lake Murray, where he married a woman who had land rights near Kawok. In 1986, their son moved back to use his mother's land
Komera	In Irian Jaya, northwest of Kungim village

Because population density is low and the village is small, the villagers report that there is plenty of game in the forest and swamps surrounding the village. There are no other villages along the north side of the Fly River from the Ok Tedi to Kiunga, so there is little competition for resources. The closest group of refugees is at Kuyu camp; they do not exploit resources belonging to people from Kawok.

Although regular transport to Kiunga is available, the people from Kawok do not tap their rubber trees — a fact which they explain in terms of the low price and their distrust of the businessman who controls the provincial rubber trade. They do actively market their produce in Kiunga. There is no medical aid

⁵ The configuration of the junction appears to have changed between MacGregor's visit in 1890 and that of Karius and Champion in 1926. The narrow canoe passage to the north of the present junction appears to have been the main channel in 1890, with the land between, now marked as Ferguson Island, named Morchead Island by MacGregor (Champion 1966:19).

post in the village; if someone becomes ill, he or she will be taken to Kiunga for treatment. Children go to school in Kiunga as well.

There are six motor canoes based at Kawok. There is one operating tradestore, three houses have iron roofs, and there are two water tanks in the village. There have been six graduates of tenth grade. Seventy percent of recent marriages have been within the village.

The villagers belong to the Catholic Church and are still very active in traditional religious and ceremonial activities. In 1987, the people of Kawok staged a pig feast for which some fifty pigs were slaughtered. They still make use of divination and curing practices, and actively initiate their young men into the male cult. Their most recent initiation ceremony was held in June 1992; five young men from the village participated.

The greatest problem facing the people of Kawok is their fear that OTML operations at the Kiunga wharf are polluting the Fly River. Even though the village is built on the banks of the Fly, the people living at Kawok no longer make use of the river. They do not drink from the river or swim in its waters. They no longer eat fish from the Fly because the fish are said to 'taste bad' and have 'no fat'. Whereas they used to catch turtles with fishing line and dig up turtle eggs, they report that today few turtles come up the Fly to lay their eggs. They claim that someone from the 'company' told them not to make sago on the Fly River. Since sago production requires a supply of fresh water, which may be difficult to obtain in sufficient quantities in the swamps, riverine sago palms are a significant resource. Only a few people make gardens along the Fly River because most people fear the pollution from OTML operations in Kiunga. The village has turned its back on the river that once was its *raison d'être*.

The villagers are also concerned about the recent deaths of several animals that washed ashore. Two turtles, one with a broken shell, were recently found beside the Fly and three mature crocodiles were also found dead. The deaths of three pigs kept near the Ok Tedi were blamed on the 'harmful effects' of the river. The villagers attribute these animal deaths to problems in the environment caused by the mine.

Another ecological concern of the Kawok people is that the forest land and swamps to the north and northwest of the village abut onto the Ok Tedi. The villagers are concerned that the Ok Tedi might rise above the river bank at that point, flooding their land and transporting mine wastes into their wetlands. They have seen how areas of forest fringing the Ok Tedi have been damaged, even as far south as the Fly River junction, and are concerned about the potential impact of such a flood. They depend very heavily on these swamps to provide them with fish, prawns and sago. While I do not know the slope or gradient of the land involved, the low-lying land between the Ok Tedi and Kawok may well be in jeopardy.

Moian Village

Moian (1980 population, 235; latest count, 420) is located on Ok King creek, which leads into Ok Inggin, a tributary of the Fly. The village was founded about 1950, about the same time that the government post in Kiunga was re-established after World War II. According to the Electoral Roll of 1967 (Territory of Papua and New Guinea 1967), there were originally three separate settlements, known as Moian #1, Moian #2 and Moian #3, with populations of 65, 41 and 13 adults respectively.

The residents of Moian have rubber trees, but do not wish to tap the rubber until the price increases from the current level of 18 toea/kilo to 35 toea/kilo. They sell garden and forest produce at the market in Kiunga, but no longer sell riverine produce out of concern that it will cause illnesses for which they will be held responsible. There is both an aid post and a school in the village, eight or nine motor canoes, five tradestores open for business, seven houses with iron roofing and four water tanks. There are no refugee populations nearby. Four of the last ten men from the village to marry found wives from the village.

The village is Catholic. Villagers still make use of traditional divination and healing techniques, attend pig feasts sponsored by neighbouring villages, and participate in male cult ceremonies. Young men often do not wish to participate in these rituals, but the older men are optimistic that the traditions will continue.

The villagers are quite concerned about the 'copper pollution' that is entering the Fly River at the wharf in Kiunga. That this threat is largely invisible, in contrast to the heavy loads of sediment that are clearly borne by the Ok Tedi, seems to increase anxiety about its impact on village resources. While the village stands on land at some distance from the Fly River, the people are very concerned that the 'copper pollution' will enter their local waterways and wetlands when the water level of the Fly is high enough to back up into its tributaries.

The people from Moian no longer make use of the resources of the Fly River or the adjacent river banks. They told me that a 'scientist' visited the village and told them not to make gardens along the river. Some people make their gardens along the tributaries of the Fly, but most have moved their gardens inland. As a result, their gardens are no longer as productive, because land away from the river only yields one or two crops, whereas land along the more fertile river bank continues to bear fruit. They no longer catch fish or other aquatic life from the Fly. In the meantime, there are plenty of fish, turtles and crocodiles in the feeder streams and swamps, but the people of Moian wonder whether these, too, will soon be affected. They do not harvest sago palms that grow along the Fly River any longer. Elsewhere, sago is plentiful. There is enough game at the moment, but they no longer hunt near the Fly. Finally, they have lost access to the cash they used to obtain by selling fish at the markets in Kiunga. They refuse to sell fish because the buyer might become sick and blame them for the illness.

The people of Moian want OTML or the government to compensate them for their loss of access to resources associated with the Fly River. Whereas OTML might perceive that local losses are far outweighed by general improvement in the region's economic situation, (for example, many of the people who purchase goods at Kiunga market would not be employed were it not for the mine), the people of Moian want to be compensated directly for each specific resource they have lost. Villagers want to increase their share of the VDF monies, which they say amounted to only K32 per person in 1992 (K10,000 divided by 310 people — adults and children). They say that the money is insufficient compensation for the losses they have incurred. One man suggested that K200 or K300 per person would be a reasonable annual payment, but others disagreed with him immediately. They say that they 'suffer' as much as the people who live along the Ok Tedi and therefore should receive commensurate VDF payments.

Ulawas Village

Ulawas (1980 population, 123; latest count, 302) is the closest Yonggom village to Kiunga. Yonggom people settled in the area sometime before World War II, after fighting off the local Awin inhabitants. An interesting problem regarding land ownership resulted from this turn of events; no one claims ownership of the land on which the village stands.

Even more than its neighbouring villages along the Fly, Ulawas functions as an outlying suburb of Kiunga; its ten motor canoes operate like taxis. Children go to school in Kiunga (or in Moian) and villagers receive health care there as well. There are no trade stores, as people travel easily to Kiunga to make their own purchases. There are five houses with iron roofs and five water tanks in the village. There have been ten graduates of tenth grade. In the last nine marriages, six men found partners in the village.

Ulawas is Catholic and its people still actively participate in traditional activities such as dances, divinations and healing ceremonies. They have, however, given up male cult ceremonies, and young men are no longer initiated into the cult. In July of 1992, the villagers were busy constructing a compound for a pig feast that they planned to host in December 1992. This requires a very substantial investment of labour and is a good indication of the vibrancy of the community. People from a number of Ok Tedi and Fly River Yonggom villages were expected to attend.

When the waters of the Fly River are high, they flood into the creek that leads to Ulawas. The people are concerned about what they call 'copper pollution' and how this affects riverine life. They say that they no longer make gardens or harvest sago along the Fly. Inland, there is no impact from the mine and there is sufficient game for them to hunt, although they were disturbed by the sight of a cassowary covered by 'boils'.

Even though the operations at Kiunga have not had a great impact on them, they are concerned about the future possibility that the 'copper pollution' will enter the local food chain. They wonder what will become of them should they no longer be able to make a living off the land. Will the company feed them? How will they survive?

People in Ulawas have rubber trees, but do not tap them because of the low market price. They sell food at the market in Kiunga, but they do not sell fish from the Fly River, because they are concerned that it will cause illness.

Summary

People from Kawok, Moian and Ulawas all expressed fear and concern about the impact of OTML operations at the Kiunga wharf on the Fly River. All three villages also report that they were told not to exploit the resources of the Fly River, including river bank garden land and sago stands, as well as fish, crocodiles and turtles. There was disagreement and confusion as to whose instructions these were; some people referred to a 'German scientist' and others to either 'the company' or 'government officers'. A second dimension of the problem is that villagers are no longer able to sell riverine produce at the Kiunga market, because the people living in town are also concerned about the possible impact on their health posed by the wharf operations. People at Kawok village also pointed to the crocodiles and turtles that washed up onto the river bank in the past year as evidence of the polluted state of the Fly River.

There are at least four potential sources of pollution from wharf operations in Kiunga (Don Cooper, OTML operations, pers. comm.):

- Leakage of oil and gas and other petroleum products directly into the Fly River. OTML is currently taking steps to recover and recycle these losses. Part of this effort involves lining the wharf with concrete and the construction of a drainage system. Recovered petroleum products will be transported to Tabubil where they will be burned as fuel.
- Release of copper concentrate from the copper dryers in exhaust fumes during system malfunction and miscellaneous wind transport of copper concentrate from the storage sheds and during loading of ships. According to OTML, neither of these problems are enough to pose a serious health threat.
- After processing, the excess water from the copper slurry line is released directly into the river system. It is obviously in the company's economic interest to have a high copper recovery rate and, given recent improvements in the process, OTML claims that there is little danger that significant amounts of particulate copper will be released into this portion of the Fly River. The company has begun construction of several settling tanks, which should increase copper recovery and reduce the discharge of copper into the river. There may be some confusion regarding this process, because the effluents from the town sewage system are released into the river from the wharf as well.

- The reagents used to extract the copper concentrate at the wharf, including frothers, collectors, a drying agent and flocculent. First, most of the reagents are organic chemicals, which break down in sunlight. Second, most will adhere to the products and, therefore, will be removed from circulation. Finally, the amount of the chemicals used is very small — in fact, according to OTML, too small even to be measured in the Fly River.

There are several other factors that may influence riverine life along the Fly between the Ok Tedi and Kiunga. The first is the increased river traffic along the Fly, including the barges which transport copper concentrate, supply ships to Kiunga, and quite a number of canoes powered by outboard motors. Collision with the propellers of any of these could be fatal to both crocodiles and turtles. It is possible that the wake of larger vessels may disrupt turtle movements and egg-laying behaviour. Also, the changing hydrology of the Ok Tedi will affect the flow of the Fly River above the Ok Tedi junction, causing the Fly to back up when the Ok Tedi is flooding. Finally, intensive harvesting of turtles and turtle eggs for sale at the Kiunga market during the 1980s could have had an impact on current populations.

Assuming the accuracy of the information regarding the limited environmental impact of the operations at the Kiunga wharf, the concerns and fears of the villagers along the Fly River between the Ok Tedi and Kiunga may be somewhat exaggerated. Nonetheless, until the people of Kiunga and the villagers living along the Fly River are convinced that the discharge from the wharf is not harmful to them or to their environment, the villagers will not make use of the full range of their resources and will continue to be deprived of what was previously an important source of cash income — the sale of riverine produce at the Kiunga market.

The major need of these villages is an additional source of cash income. Given the low cost of transport between these villages and Kiunga, the villages are well-suited for small-scale development projects producing goods for sale at the Kiunga market. This would partially compensate for lost earnings from riverine produce and supplement current sales of pig and cassowary meat, bananas, sago, greens and sweet potatoes at the Kiunga market.

ZONE 2: THE FLY RIVER FROM THE OK TEDI TO BINGE RIVER

Overview

There are four villages along the Fly River from the Ok Tedi to the Binge River (see Figure 1). Erehta is close to the Fly on the Ok Yimbusi creek. Kukujaba is a Boazi village on the Binge, not far from the Fly. Membok and Karengu are Yonggom villages located further upstream along the Binge.

People from all four villages expressed great concern about the impact of OTML on their environment. The amount of suspended sediment in the Fly

River has increased greatly since 1989. According to local informants, the trees growing beside the Fly River are beginning to show this impact. When the water level of the Fly is high, mine wastes are forced into the Ok Yimbusi, which runs through the centre of Erehta village; the new steel bridge built by the Trust at Erehta becomes submerged during floods. Water from the Fly River also backs up the Binge as far as Kukujaba village. People are worried and frightened about the potential toxic impact of the minerals and chemicals that may be released into the river system by OTML — especially the impact on local aquatic life. This fear has caused some people to give up exploitation of riverine resources.

Erehta, which used to rely heavily on resources from the Fly River, has the fewest assets of any of the four villages. It is far from the nearest school or aid post and, given that villagers cannot sell fish in the Kiunga market — once their major source of cash income — they are largely unable to afford the fuel to travel to Kiunga. Refugees from Niogamban camp also make use of their resources. In contrast, the villages of Membok and Karengu are in relatively good economic shape. However, the people of Kukujaba lag behind their neighbours, which may be attributed in large measure to the fact that they have recently abandoned their traditional pattern of seasonal movements.

Erehta Village

Erehta (1980 population, 146; latest count, 289) was established at its current location in the mid-1950s; its inhabitants migrated to the region from west of the border, near present-day Mindiptanah, at least seventy years ago. Legend has it that a man named Wunop was the first Yonggom settler. Wunop killed a python and from its stomach emerged an Awin man. After establishing boundaries between the Yonggom and the Awin, Wunop brought his family east to settle near the Fly River.

The villagers are members of the Catholic Church. They still actively participate in traditional activities; they dance and attend pig feasts, hold curing ceremonies and divinations, and about half of the men in the village are initiated. Nine out of the last ten men to be married found wives from the village.

Erehta is very isolated. There are six privately owned motor canoes and two more canoes provided by the provincial government, but the fuel for the three to four hour trip to Kiunga is very expensive and the villagers have no regular cash income. There are no houses with iron roofs, but there are three water tanks in the village. There have been seven graduates of tenth grade.

They have a large block of rubber trees, but they cannot afford to transport the rubber to Kiunga, and inspection showed that there had been no tapping recently. There is no aid post in the village and people must travel to Moian or Kiunga for health care. There is no school in the village, so children attend primary school in Membok, Moian or Kiunga. Parents often find it difficult to

raise the money necessary to pay their children's nominal school fees. There is one operating trade store in the village.

The people at Erehta identify the lack of health care as their biggest problem. They think that there should be an aid post in the village. It takes too long and is too expensive to travel to the nearest aid post in Moian or Membok; as a consequence, when people fall sick they frequently go untreated until they become critically ill.

A second problem that the villagers face is competition for resources by the refugees at Niogamban (1992 population: about 400). The refugees clear forest to plant gardens, harvest sago palms and hunt on land belonging to the villagers. The refugees say that the government ignores the refugees, and that they are unhappy about the lack of government initiative in moving the refugees away from their property.

A third problem facing the people from Erehta is the impact of mine wastes on the Fly River and its feeder streams. The Fly River is only twenty minutes from the village by foot, thirty minutes by canoe, and the people from Erehta used to rely heavily on its resources. When the water levels of the Fly River are high, it backs up into the Ok Yimbusi, the creek that runs through the centre of the village. When the water recedes, it leaves behind deposits of mine wastes.

The villagers say that the leaves of the trees along the Fly River look different from before. They know that this is one of the effects of the mine and they want a full explanation. They trust their own observations: the river has changed colour, the leaves of the trees have changed colour, there are fewer fish in the river. They told me that they are concerned because they are unable to determine whether there are harmful chemicals in the water or not. As a result, people do not want to eat any food that has come into contact with water from the Fly River. They said that even if someone from OTML came to the village and talked to them about the consequences of the mine on riverine life, they would not know whether they were being told the truth and, hence, if it was safe to eat these foods.

They report that there are still fish and prawns in the Fly and the nearby swamps and creeks, although fewer than before, but that they no longer catch and eat them. Sometimes, when they are hungry for meat, they will eat fish and prawns from the river, but they are afraid that this will make them ill. They say that people in Kiunga will no longer buy their fish at the market. This, they say, has resulted in a significant loss of cash income and has removed a way of paying for canoe trips to Kiunga.

Gardens used to be made along the Fly, but are no longer maintained there because the sites are covered in waist-deep mud. This forces them to make their gardens in the forest, where only one good harvest can be obtained. They say that okari trees along the Fly no longer bear fruit. While some of the sago trees along the Fly and the small creeks are unaffected, others have only water inside, instead of fibrous starch-bearing pith. People have stopped using the sago palms

growing along the Fly and now travel long distances to find mature palms. The problem is compounded by the fact that the refugees use their sago trees as well.

When they hunt, they cut open the animals to see whether they are safe to eat. If the animals look healthy (i.e. have 'fat' and 'plenty of blood'), they will eat them. If the animals are too thin or do not look right, they will not eat them.

The villagers do not understand why international law does not protect them against pollution from the mine and why crocodiles, fish and other riverine life are not protected. They think that OTML and the government are crazy (literally 'lacking sense') for not protecting the environment. They complain that the 'government is sleeping' and that the provincial government wastes the money that it receives from the mining operation and from the national government. They are frustrated by the lack of coordination between the different agencies that provide them with services, including the company, the government and the church, and that they fall through the cracks as a consequence.

The people of Erehta say that they are hungry and that they have no money to buy food, matches, soap, or kerosene, or to pay the school fees for their children. Their second most reliable source of cash income in the past (after rubber), which was selling fish at the market in Kiunga, is no longer an option for them. They have no health care close by. They no longer make use of important resources from the Fly River and have to compete with the refugees for those that remain.

Membok Village

Membok (1980 population, 166; latest count, 413) was founded in 1963, when two earlier settlements, Ungerrem #1 and Ungerrem #2, combined. While the land surrounding the village is divided among Yonggom villagers, the people from Kukujaba claim ownership of the entire area, saying that they gave the Yonggom people their permission to establish the village.

Because of the airstrip run by the Montfort Catholic Mission, the aid post and the primary school, Membok is the hub of the three Binge River villages. The schoolteachers maintain regular radio contact with the Catholic Mission. A long block of rubber trees runs along the wide path between Membok and Karengu, but no one taps the trees because of the high transport costs and low price for rubber. People from the village occasionally take goods to the market in Kiunga by motor canoe, but it is a long journey for them. There are ten motor canoes in the village, but trips to Kiunga are infrequent. There are five houses with iron roofs. The last nine village men to marry found partners divided equally from Membok, Karengu and the refugee camp at Kuyu.

There are ten graduates of tenth grade in Membok. The villagers are Catholic. They hold traditional dances occasionally, usually on calendrical holidays (e.g. Independence and Christmas). They still use divination and curing practices. They will attend pig feasts, such as the 1987 feast at Kawok, but have

not taken their young men to male initiation ceremonies in other villages, mainly because of time constraints.

The villagers have had few problems with the refugees living at Kuyu camp (population: 800), largely because of the distance between the camp and the village. Some of the landowners of the Kuyu camp site live in Karengu. There have been disputes or fights in the past — concerning hunting practices, for example — but they have been resolved.

People in Membok and Karengu do not garden as extensively as do their neighbours to the north; their major staples are sago and fish. When they do make gardens, the major crops are bananas and cassava; the latter has gained in popularity since the arrival of the refugees in 1984.

The people claim that their local environment is changing. When the water level of the Fly River is high, the Binge reverses direction and water from the Fly is forced upstream. While the mud or sediment from the Fly River is not carried as far as Membok, its 'power' is said to affect the local ecosystem. They are not happy with the company because it has been 'spoiling' their environment and they no longer have enough to eat.

They are afraid to eat the fish that they catch in nearby creeks. Sometimes the fish are very thin, in other cases they are too white inside; they have no 'blood'. They also found fish with what they call 'copper rocks' in their stomachs, so they gave up eating fish. Last year a man that they identified as a 'German scientist' came to the village and reportedly told them not to eat the fish or sell them in the market. According to the aid post orderly, however, even though people have complained to him about the fish, he has not observed any problems. He also says that the people from the village still eat the fish. Village health status has stayed relatively constant during his four years; there are serious problems with malaria, but it does not seem to be getting worse.

They report that, when they harvest sago palms which have been submerged during flooding of the Fly River, there is no starch inside, only water. In contrast, the sago palms found away from the Binge River are fine. The 'power' from the water in the Fly River is said to affect the plants so that gardens do not develop properly, the bananas are dry and not good to eat, and the sweet potatoes stay hard even after they are cooked. They say that when animals come to drink from the river, and they catch them and cut them open, they do not have 'blood', or their lungs are filled with mucus. Otherwise, there is still enough game for them to hunt.

The village lies on a shallow strip of land surrounded by swamps. Sediment deposited at the mouth of the Binge River causes the river to back up, raising the water level of both the river and the connected wetlands. If this occurs on a large scale, it is possible that the village will permanently cede ground to the swamps. Currently, natural flooding affects only the low ground around the village and only for limited periods of time. If present rates of sedimentation continue, it is possible that the village may no longer be fit for habitation.

Their share of the VDF monies amounted to about K20 per person, which they do not consider sufficient. They want more money and more projects from the mine in return for its impact on their environment.

Karengu Village

Karengu (1980 population, 128; latest count, 586) is close to Membok along a well-travelled path; people from Karengu make regular use of resources at Membok. There are five graduates of tenth grade from the village. There are four houses with iron roofs and one water tank in the village. The people are all Catholic. Given that I interviewed people from both villages together, the information presented above also reflects the views of the people from Karengu.

Kukujaba Village

The people living in Kukujaba (1980 population: 132) are Boazi speakers. They previously lived at the mouth of the creek leading to Membok; in the early 1960s, they moved to a place they call Kukujaba. More recently, they moved to Kimbagaip, which is closer to the mouth of the Binge River (which they call the Bimagai). They are still referred to as the 'Kukujaba' despite their move to Kimbagaip. They own all the land along the Binge, including the village sites of Membok and Karengu.

People from Kukujaba visit Membok frequently; about twenty of their children attend its primary school, they receive medical treatment there, and they occasionally fly to Kiunga from its airstrip. Ten or twelve families from Kukujaba with children in the Membok school have built houses on the far side of the airstrip, where they stay during the school year. Despite the presence of a Boazi-speaking schoolteacher from Bosset, the children do not do as well in the school as the Yonggom children. The Boazi and the Yonggom get along well. They can understand some of the other's language, but do not speak it. They communicate with each other in Hiri Motu.

Like their neighbours, as well as the large Boazi community at Bosset, the people at Kukujaba are Catholic. They still follow traditions for curing illness and for funerals. They have feasts at which they kill pigs and maintain a men's house. They have given up many other customs.

Their comments on environmental change are similar to those voiced by people from Karengu and Membok. They say that, when they harvest sago, the pith is soft and watery. Their bananas bear fruit, but the fruits are smaller than normal. The sweet potatoes are no good. Some of the fish they catch have 'no blood', so the people refuse to eat them. Before the mine began production, animals used to come to the Fly River or its side creeks to drink, where they could be caught, but now this is uncommon. Today, even when animals do come to the river, they may die and fall into it. When the Fly River floods into the Binge, they are afraid to even touch the water, whereas in the past, people sometimes drank directly from the river — a practice I witnessed during a visit

to Membok and Karengu in 1986. Today, only some of the villagers are willing to swim or bathe in the Binge. They will not hunt near the Fly or harvest sago from beside the river any longer, making it difficult for them to produce enough food to eat. They have to travel long distances for sago and for game.

The Kukujaba people are pleased that the company has established a trust fund and is setting up projects and giving out VDF money to villagers, but they do not think that the company has given them enough to compensate for the damage to the river that it has caused.

Like their neighbours, they have rubber trees that they do not tap. Because they only began sending their children to school in 1985, there are no high school graduates from Kukujaba. Many of the Kukujaba students in the grade school are five or six years older than their Yonggom peers. Compared to their neighbours in Membok and Karengu, the people from Kukujaba look somewhat bedraggled. This has much to do with their lack of participation in the cash economy. No one from Kukujaba, for example, works in Kiunga, and their only access to cash is through occasional sale of crocodile skins. There are no houses with iron roofs in the village, but there are three water tanks. The people from Kukujaba are relatively isolated from their fellow Boazi, who, because of the long-standing mission presence at Bosset, are otherwise one of the better educated groups in the province. Their subsistence strategies include large hunting expeditions that burn the rainforest to drive the animals out, a little gardening, and less intensive methods of sago production (see Busse 1987). These strategies may be better suited to a mobile style of life, moving from camp to camp, which they have recently abandoned.

Summary

Erekta is the most adversely affected village in this zone. The villagers now make little use of resources from the Fly River and claim it is no longer possible to sell fish in Kiunga. This effectively marginalises the villagers, because they can no longer afford to travel to Kiunga or participate in the regional economy. Additional pressure on their resources, including garden land, sago stands and wild game, comes from the 400 refugees at Niogamban Camp who live on Erekta land. Since the nearest aid post is nearly three hours away by outboard motor, villagers at Erekta lack both regular medical care and efficient access to emergency treatment. Informants here expressed frustration with OTML and have had conflicts with staff from the OTML Environment Department in the past.

The villages along the Binge are in relatively good economic shape. Their concerns about the environment, however, need to be addressed. The resources that they exploit need to be examined for negative environmental impact, including the consequences of sedimentation at the junction of the Binge and Fly Rivers.

ZONE 3: VILLAGES WEST OF THE OK BIRIM JUNCTION

Overview

Kungim, Kungembit and Ambaga are situated in the foothills west of the junction of the Ok Tedi and Ok Birim rivers (Figure 1). People living in the three villages own land beside the two rivers, but most of their subsistence activity takes place in the foothills several kilometres west of the river system. Despite their distance from the Ok Tedi, people from all three villages blame the mine for what they perceive to be a general decline in the productivity of their land and the availability of resources, including gardens, sago stands, game and riverine life.

These detrimental effects were variously attributed to the 'power' of the mine, the impact of 'copper medicine' on the environment, and to 'pollution' from the mine that was 'coming up through the ground' or 'in the rain'. These attributions are very similar to statements made by landowners in Bougainville regarding the environmental impact of the Bougainville copper mine — a comparison to which I shall return in subsequent discussion.

Because Kungim has an airstrip and is a Montfort Catholic Mission station, it serves as the hub of the three villages. Kungim is not currently a member of the Trust but, for reasons I set out below, I recommend that it should be included in the future.

Kungim Village

Kungim village (1980 population, 483; 1990 NSO count, which includes refugees, 1587) is a Catholic Mission station on a village site founded in 1952 by a Dutch patrol officer. When the border was later surveyed in the 1960s, the village was found to be in Australian territory, and administration of the station was taken over by the Montfort mission based in Kiunga. Kungim village lies approximately 4 km northwest of Kungembit and 2 km north of Ambaga (see Figure 1).

The village has no rubber groves, no road access and no means of transporting goods to urban markets. The village is distant from the river and the villagers therefore own no motor canoes. The people depend almost entirely upon mission aircraft for the transport of goods. There are four trade stores in the village, six water tanks, no houses with iron roofs, and twenty graduates of tenth grade, none of whom have found work. All of the last ten marriages were arranged within the village. While the villagers are members of the Catholic Church, they still stage dances, hold pig feasts, conduct divinations and carry out initiation ceremonies.

The refugees arrived in 1984; a census in 1988 estimated that there were 940 people living in the camp (Preston 1988:21). Today, only a small number of refugees are actually resident in Kungim at any give time — perhaps only 60 to

100. Several hundred other refugees claim official residence at the camp, and will return for certain events or census-taking. Regardless of the number of people at the camp today, the presence of large numbers of refugees at Kungim from 1984 until at least 1990 resulted in significant depletion of local natural resources.

The people at Kungim assert that their garden land has gone bad and is spoiled (*moraron*), and that game is hard to find. They told me that, prior to the copper mine, everything was good, but now everything has turned bad. 'Copper medicine' has got into the water system; it is a 'poison' or a 'power' that cannot be seen, but it spreads through the small creeks and rivers.

The people at Kungim wrote a letter for me to take to Tabubil and insisted that they receive an answer from OTML by the end of 1992. In the letter they raised a variety of concerns about the environmental impact of the mine (see discussion below). The letter goes on to ask why Kungim has not 'benefited [from] some sort of funds from the company'. They ask that the '722 people' living in '61 houses' be included in the next round of the Trust projects and the annual distribution of VDF monies.

Kungim is the only Yonggom village in the Papua New Guinea border area⁶ that is not part of the Trust. This situation has made Kungim villagers frustrated and angry, and has created friction and conflict between them and their neighbours in Ambaga and Kungembit. Kungim was one of two villages where people were hostile to me in my role as interviewer; here they threatened dire consequences if I did not report their complaints to OTML, *and get a successful outcome for them*.

Inquiries about land holdings revealed two cases of Kungim residents having rights to land on the Ok Tedi, east of their village. Land on Deetbit Island is partially owned by members of Kigo-Deetbit lineage, who live in both Kungim and Kungembit villages.⁷ Land at the junction of the two rivers, in the area known as Birinkaba, is claimed by members of both villages as well.⁸ Given that ownership of land on the Ok Tedi is a criterion for membership of the Trust, Kungim village would seem to be so qualified.

Kungembit Village

Kungembit (1980 population, 127; latest count, 155) was founded about 1955; prior to that, the people lived in very small, scattered hamlets. They have no

⁶ Nago and Buseki are non-Trust Yonggom villages on Lake Murray.

⁷ Awin people claim land on the eastern side of the island, opposite Alice Pit (John Burton, pers. comm.).

⁸ I see from King's (1993) report that 'Birinkaba' is listed as a Trust village and, indeed, that 211 people are enumerated as its residents. The existence of this settlement is a surprise to me, as I am only aware of a few garden houses at Birinkaba. Consequently, I cannot say who the residents are. This is not a village listed by the government for census.

rubber trees, but sometimes take dried coconuts, sago flour and bananas to Tabubil market. There is a new Yonggom language literacy programme for preschool children in the village, but they attend primary school and make use of the aid post in Kungim. Ten students from the village have completed tenth grade. There are two houses with iron roofs and two water tanks in the village.

Given their distance from the river, they have no motor canoes. Six of their last ten marriages were arranged within the village. They are Catholic, but continue to participate in a variety of traditional rituals, including dances, divination and healing ceremonies and pig feasts; in 1992, they held a male initiation ceremony for four village boys.

When the refugees came in 1984, they started making gardens on Kungembit land without first gaining permission to do so; the villagers destroyed the new gardens and chased the refugees away. In response to my questions, they told me that the refugees no longer hunt on their land or fish in their creeks.

It is their opinion that, while the projects supported by the Trust are good, they do not 'satisfy' the people. In terms of future development, they want a road project that will connect them to Ningerum. They complained that no one from the company comes to talk to them apart from the people installing the tanks and the representatives of the VDF. Furthermore, they say none of these people 'explain anything' to them. They want to meet with and talk to people who can explain to them what the mine is doing.

The people at Kungembit also report having difficulties in food production, including their gardens. They say that when they cut down their sago palms, many of them have no starch. They attribute this to mine pollution in the following way: contaminated vapour or smoke rises up into the clouds at the process plant (at the mine), is transported in the clouds, and then falls down on their sago stands and gardens some 50 km away.

Ambaga Village

Ambaga (1980 population, 194; latest count, 327) is a little more than an hour away from Kungim by foot, and roughly four hours walking from Ningerum. Its inhabitants have no rubber trees to tap, no means of transporting produce to urban markets, and no trade stores. The nearest aid post and school are at Kungim, but they do have a village literacy programme like the one at Kungembit. There are no houses with iron roofs, but there are two water tanks in the village. Because of their longstanding access to school at Kungim, there are sixteen graduates of tenth grade from the village. Nine of the last ten marriages were arranged within the village. The population is divided between the Catholic Church and the Evangelical Church of Papua; members of the former still practice various rituals (e.g. divinations and healing ceremonies), while the latter do not.

Residents of Ambaga appreciate the projects set up by the Trust and request more food-producing projects. They would also like an aid post for the village; Kungim and Komokpin are too far away for sick people to walk. Their annual payment from the Trust amounted to only K43 per person (divided among all men, women and children), which lasted only one or two months. They are aware that people in other villages are receiving larger payments and question the disparity, given that they are suffering from a food shortage themselves.

They told me that they could 'see with their own eyes' that 'the river has turned bad'. They say that their crops (banana, taro, etc.) have been affected as well, producing food that is 'bone only; it has no body' (*kono mo; it yipban*). There are similar problems with their sago stands and other important tree crops (pandanus, breadfruit and okari). The problem extends to fishing and hunting as well. They say that there are few fish or prawns in their creeks; even with a net they do not have much success. Hunting has similarly declined. Although they claim not to have had any confrontations or problems with refugees from Irian Jaya, the added pressure on the land while the refugees lived in the Kungim camp probably affected resource utilisation as far south as Ambaga. For example, the path between Ambaga and Kungim was heavily gardened, with little uncultivated land.

Their explanation for the general ecological decline is that the 'copper *marasin*'⁹ used by the mine is carried downstream by the Ok Tedi and comes up through the soil. Although the Ok Tedi does not back up into its tributaries as far as Ambaga, even when it is flooding, the 'copper *marasin*' is thought to spread through the small creeks and rivers.

People from Ambaga say that, while they were previously healthy, now there is a food shortage and people are becoming ill. Their teeth are rotting. Their children are suffering because there is no meat for them to eat. They are concerned that people with illnesses will die because there is not enough food for them. One man told me, 'If I die, OTML will be responsible (*dabap kandanip*); they should be afraid'.

Summary

The villages of Kungim, Kungembit and Ambaga are located in the foothills to the northwest of the Ok Tedi. Despite the distance from the river and the difference in elevation, villagers claim that the 'copper *marasin*' in the Ok Tedi has poisoned their environment, affecting everything from wild game to crops in their gardens, and is causing sickness in humans, with symptoms ranging from rotting teeth to breathing difficulties.

Many of the problems that the people in this region attribute to the mine may be better explained by a combination of general changes in their lifestyle and diet, and the gradual, but nonetheless very real, depletion of local resources

⁹ The meaning of *marasin* here is discussed in more depth on p. 68.

— a process greatly accelerated by the presence of a thousand refugees over a five-year period. The refugees probably greatly depleted local game resources, and their use of garden land may have led villagers to build new gardens after inadequate fallow periods, a practice that could account for reports of substandard yields.

One indication of the stress on resources faced by the villagers in this area is the presence of a new style of gardening that involves intensive cultivation of several varieties of root crops in small plots. Until recently, the Yonggom had only one type of garden, which was a large, unfenced and mixed garden, dominated by bananas but haphazardly planted with a small percentage of other crops and fruit-bearing trees.

The new gardens are quite different. Typically, the plot is square or rectangular, no more than five to ten metres across. The edge of the garden may be marked with short, crossed sticks. A single row of cassava, referred to locally by the Malay term *ubi*, is frequently planted along this border. Sweet potatoes are planted in highlands fashion, in the centre of mounds separated by drainage channels. Staked yams are planted in another section of the plot, and taro is planted where the plot drains. The Yonggom only infrequently planted root crops in the past. These small gardens, which have become ubiquitous over the past three to four years in the villages along the Ok Tedi (both Zones 3 and 4) are a sign of agricultural intensification in response to land pressure and resource shortages. In addition to their greater yield, these new gardens, which are mulched, are typically made on land not otherwise suitable for horticultural use. There were, for example, a number of these new root crop gardens in the abandoned refugee area beside Kungim village. These new techniques require more intensive labour, but enable the villagers to make better use of limited land resources.

The people in the three villages are also unable to participate in the regional cash economy because there is no road linking them with Ningerum. Several years ago, villagers took the initiative to begin clearing a road from Kungim to the Ok Tedi-Ok Birim junction. There would be considerable support for government efforts to complete this road.

ZONE 4: OK TEDI RIVER VILLAGES

Overview

In Zone 4, the Ok Tedi undergoes a transition from a fast-flowing, sloping river that transports its load of suspended sediment downstream, to a sluggish, meandering river that begins to release the finer sediment that it carries. While the greatest overall volume of deposited mine waste may now lie above Ningerum, parts of Zone 4 below Komokpin are particularly vulnerable to overbank flooding and have sustained a high level of damage from material deposited *outside* the channel.

As a consequence, the area has been hit hard by the mine waste. It has been deposited onto forest and garden land, into adjacent wetland areas, and upstream into the numerous creeks and streams that flow into the Ok Tedi. This is in stark contrast to the alluvium that once fertilised the river's flood plains, turning them into ideal garden land. The mine wastes have had an adverse impact wherever they have been deposited, killing plants and trees, and disrupting local ecosystems. The damage extends for forty kilometres or so along the river, with areas of dead trees that extend up side creeks up to three kilometres from the main channel. There has been little regrowth to date, and large areas are virtually devoid of life. This land was particularly valuable to the villagers because it is located within easy walking or canoe distance, and because it offered resources not readily available in the rainforest interior. Up to the time of fieldwork, little formal assessment of the environmental damage had been made and no compensation paid.¹⁰ As may well be imagined, the villagers in this zone are in a state of despair and, despite the work of the Trust in bringing some new facilities, feel frustrated and ignored in their efforts to obtain restitution.

Over two thousand people live in the eight villages in the area. Another thousand live in refugee camps at Dome and Yogi. These people are dependent upon local resources for the vast majority of their subsistence needs. The impact of mine wastes released into the Ok Tedi has challenged the abilities of the people along the lower Ok Tedi to feed themselves. One measure of this is the presence of intensified root crop gardens that have sprung up throughout the region since 1989.

These people have lost access to garden land along the fertile river flood plain, which has been covered by mine wastes. Now they must compete for plots in the rain forest that produce one or two harvests at most. There are fewer fish in the Ok Tedi and most people are afraid to eat them. Few turtles come up the Ok Tedi to lay their eggs; formerly this was an important seasonal resource. Many of the small creeks and streams that feed into the Ok Tedi are choked with mine wastes; it has become difficult to catch prawns and crayfish. Some sago trees along the river have died; other trees in adjacent wetlands are threatened. Still other sago stands have been swallowed by the widening of the river. The forest along the river was also once a rich hunting ground for animals that came there to drink.

Komokpin Village

Komokpin village (1980 population, 123; latest count, 334) was founded in the 1940s at the direction of an Australian patrol officer. The land on which the village is built belongs to the Marapka lineage and is controlled by a woman named Kupa; her sons will control the land after her death. Most of the villagers belong to the Evangelical Church of Papua; they claim to have given up

¹⁰ This was still the situation at the time of writing the original report (mid-1993). See extended discussion on p. 94.

their 'customs' in favour of Christianity. A handful of people consider themselves Catholic, although they do not have a church or hold services in the village. There is an aid post and a school in the village; there are four motor canoes, two operating tradestores, eleven graduates of tenth grade, three houses with iron roofs and two water tanks. Of the last ten men from the village to marry, eight of them married women who were also from the village.

In contrast to the other villages in this zone, no rubber trees were ever planted at Komokpin. It takes two days to travel by outboard canoe directly to Kiunga; villagers usually cross the Ok Tedi by canoe and then walk to the Kiunga-Tabubil highway and wait for a vehicle to stop for them. It is too far and too expensive to take vegetables or sago to sell at the market. They gain some cash from urban remittances.

People living in Komokpin say that they do not have enough food to eat. They say that when they cut down sago trees, the pith inside is hard; it does not produce starch.¹¹ Other sago palms fail to mature. They also claim a shortage of protein in their diets. They have tried to raise more pigs to compensate for this problem, but the pigs ruin their gardens.

An issue of continuing significance is the abandoned refugee camp to the northwest of the village. From 1984 to 1987, more than a thousand refugees were living there; from a distance, the area looks like an airstrip. Primary forest has been cleared over a wide area and woody regrowth is gradually taking its place. Even though the refugees left the camp in 1987, it will take another decade before this land will become available to the villagers for new gardens. The presence of game animals has similarly declined. Villagers have turned in part to intensified root crop agriculture.

The creek leading from the Ok Tedi to the village is called Ok Kamen. While the creek is clear, its bottom and banks are covered in grey mud left behind during the Ok Tedi's most recent episode of flooding. The villagers say that the water causes tropical ulcers and infections. I was told a story about a child who swam in the Ok Kamen when the Ok Tedi was backing up into the creek; two days later the top layer of his skin was said to have 'peeled off'. The child subsequently recovered, but people added that two other children later suffered the same symptoms.

People from Komokpin want the company to stop releasing mine wastes directly into the river system, and they want compensation for damage already done to the environment. If this does not happen, they think that the mine should be closed because their quality of life is no longer good. They prefer a political rather than a violent solution to the problems caused by the mine.

¹¹ This is in contrast to people from other villages, who say that some of their trees are 'watery' inside

Yogi Village

Yogi village (1980 population, 125; latest count, 222) was founded about 1960. Some of its members previously lived at the junction of At Creek and the Ok Tedi. They have rubber trees, but they are not tapping them because of the low price. They do not sell goods in the market in Kiunga, both because transport is difficult and because they lack surplus goods and food. The presence of several hundred refugees in the nearby camp (and nearly a thousand more people nearby at Dome and its camp) clearly exacerbate their difficulties in obtaining food.

Some villagers receive small amounts of money from friends and relatives working in Kiunga. There is no aid post or school at Yogi; the people make use of the facilities at Dome. There are five motor canoes and three operating trade stores in the village. There is one house with an iron roof and there are two water tanks. Eleven students have tenth grade educations. Of the last ten men from the village to marry, three married women from Yogi, three married women from Yogi refugee camp, and two married women from other Yonggom villages along the Ok Tedi.

The villagers belong to the Evangelical Church of Papua. A wave of evangelism, known as the Holy Spirit Movement or *holi*, swept the village in 1986. Soon after, expatriate missionaries built a large house beside the village. More recently, another expatriate family sponsored by the Summer Institute of Linguistics has taken their place. With the exception of pig feasts, people from Yogi no longer participate in traditional religious activities. They believe that their traditional practices 'trick people'.

I met with a group of people who voiced the following concerns, which I relate directly:

- there are no fish in the Ok Tedi;
- the sediment from the mine is harming the sago trees;
- there is copper metal scattered along the river bank;
- OTML does not come and talk to the village people;
- the sediment from the mine is getting into cuts and tropical ulcers on people's arms and legs;
- their river bank gardens have been ruined;
- gardens away from the river only produce one good crop of bananas;
- their rainforest gardens are far away;
- they do not receive enough assistance from OTML;
- they want road access to the village (at least as far as Dome village);
- they have no food to feed the chickens given to them by OTML;
- they do not want 'work projects';
- they would like a small, portable sawmill to cut timber for their houses;
- OTML should compensate them for damage to the river system; and
- OTML should find an alternative means of tailings disposal to stop the pollution.

In their opinion, if OTML does not adequately compensate them for the damages that it has already caused to their environment, and if OTML does not stop dumping its mine wastes directly into the river, then the mine should close. They will not resort to violence in order to close the mine, but will enlist the support of their 'pressure groups', ENECO and the Ok Tedi Landowners Association, in order to bring this about.

Dome Village

Dome village (1980 population, 204; latest count, 423) was established in the early 1960s. Many of the villagers previously lived in now-defunct settlements closer to the border, including those known as Woran, Timin, Kueman and Yat. The land on which the village is built is owned by members of Od lineage; an earlier settlement called Od or Ot was located to the south of Dome, at the mouth of Wuk creek.

Villagers are divided in religious affiliation between the Evangelical Church of Papua (ECP) and the Catholic Church. There is occasional conflict between the two groups regarding traditional activities, to which ECP members may object. Nonetheless, Catholic villagers still hold dances, attend pig feasts, conduct curing ceremonies and divinations, and attend male cult ceremonies in other villages.

Children from both Yogi and Dome attend the primary school at Dome, although their record in being accepted to high school is rather poor. Still, there have been twenty graduates of tenth grade from Dome. There is only one house with an iron roof and there are three water tanks in the village. The aid post at Dome is currently staffed by two medical orderlies and serves close to 1500 people, including the villagers from Yogi and Dome as well as the refugees in both adjacent camps.

The villagers have large rubber groves, which they keep in good shape, but only tap when they need currency for a particular expense (usually an exchange obligation, such as bridewealth payments). It is expensive to transport the rubber, and the people are usually at the mercy of the canoe operators who set the price. There are more than half a dozen defunct trade stores in the village; a store recently opened by a police officer who retired to the village has lasted longer than any other. One man from the village earns a living using his motor canoe to ferry various company, church and school supplies around, but otherwise there are few cash-producing ventures in the village. Many people receive small remittances from relatives employed in Kiunga.

Young men in their twenties are fairly mobile, moving to and from Kiunga, where they stay with relatives. While most prefer village life, they would settle in town if they found regular employment there. In the village, however, they often become tired of a lifestyle based solely on traditional subsistence practices.

The people at Dome are vocal about their anger towards the mine because of the impact that it has had on their environment. The tenor of village life has

completely changed. The river beside which the village was built is of no use to them. Instead of obtaining fresh drinking water from the creeks, they line up to collect water from a tank. Instead of bathing in the river, they wait for the Trust to build showers. Instead of catching fish and prawns in the river, they use VDF money to buy tinned fish. Instead of looking out onto a lush tropical landscape, they see a dirty river surrounded by leafless trees.

Their complaints about the impact of the mine on their environment and their resources echo the concerns of the people from Yogi. They point to lost riverine, garden and forest resources, which they say have been depleted to the extent that they are often hungry. They criticise the lack of communication between OTML and their village; one man showed me a letter of complaint that he said had received no response. They say that the water in the Ok Tedi slows the healing of cuts and tropical ulcers. They feel that assistance provided by the Trust to date has been insufficient and, of course, they have not yet received any direct compensation from OTML for damage to their resources. Not surprisingly, they say OTML should find another means of tailings disposal. They question whether the chemicals used to extract copper from the ore remain toxic after being released into the river. They also regard the river as more dangerous to travel on, because it is shallower and wider than before, producing hazardous currents.

Deforestation is extensive near Dome, and local people say that it is getting worse. The villagers report that their sago stands are being flooded by sedimentation that blocks the flow of water from the swamps, preventing some sago palms from producing starch. They say that gardens and sago stands must now be located far away from the village, and that hunting is only possible a long way from the village. While the presence of refugees has compounded the environmental degradation (as in Zone 3), there is no question but that the mine's impact has been particularly severe at Yogi and Dome.

Bige and Konkonda Villages

Bige in West Awin CD (1980 population unknown; latest count, 68) and Konkonda in South Ok Tedi CD (1980 population, 167; latest count, 370) are the only Awin villages that abut directly onto the Ok Tedi. They face many of the same problems as their Yonggom neighbours on the west bank of the river.

Both villages face difficulties in terms of access to resources. Many of the people with the most potential for participation in the cash economy have moved to Kiunga. Given that there is no school or aid post at Konkonda, children and people in need of medical assistance are sent to Kiunga. At the time of fieldwork in 1992, this involved a six-hour trek on foot, but a road link was completed several months later.

Many people considered residents of Konkonda actually live in Seven Corners in Kiunga. Although the settlement at Konkonda probably predates contact, its continued viability was in jeopardy before the construction of the

road. Recent census counts indicate a twofold population increase since 1990, although it is not clear whether this figure accurately represents the number of people residing in the village (1990 census, 173; 1991 OTML census, 370).

Bige is also an old hamlet; the Asia Pacific Christian Mission opened their first North Fly outpost here after World War II. The villagers are members of the Evangelical Church of Papua and no longer acknowledge their traditional religious beliefs. Bige is apparently the only Ok Tedi village whose inhabitants are tapping their rubber trees. There is no aid post or school in the village, so villagers travel to Senamrae, which is located to the north along the Ok Mart (Wai Mari) river. There is one operating trade store.

While the people at Bige expressed satisfaction with the village projects that OTML has organised through the Trust, they are upset and angry about the damage to their ecosystem caused by the mine:

They [OTML] do not know what we are feeling down here. We are hungry and we are not happy with the pollution. We do not want to shut down the mine, we just want them to build a tailings dam.

The people also expressed desire for compensation for the damage already done to their gardens and other land (see Burton 1991:26-27; Plates 1-6). For example, the land on the opposite shore of the Ok Tedi belongs to the Yonggom, but the people from Bige have permission to hunt there. Now that all the trees on this land are dying, there are no animals left to hunt.

Yeran Village

Before Yeran (1980 population, 78; latest count, 108) was founded, Marapka clan had a hamlet on the same site. Members of two clans (Dimin and Ogon) joined them later. The villagers belong to the Evangelical Church of Papua. They currently regard their traditional initiation ceremonies as 'tricking the people' and as having 'no meaning'. The related myths are regarded as 'only stories'. Not surprisingly, there is little ritual activity in the village.

They have rubber trees, but are not tapping them at the moment due to the difficulty of transport and the low price that rubber commands. They do not sell garden and forest produce in Kiunga because of their own shortage of food. They have no aid post or school, but are able to make use of the facilities at nearby Atkamba village, which is about two hours away by foot. Only three students from the village have completed tenth grade. There is one house in the village with an iron roof and there are three water tanks.

The people at Yeran point out several different effects that the mine has had on them. The mine wastes have affected their gardens along the river, as well as their sago trees. Some of their sago stands have been overrun by the widening river. They no longer fish in the Ok Tedi because they are afraid of the effect of the pollution on the fish. The deforestation along the river has also affected their hunting. They used to be successful in setting traps and tracking pigs and other animals that came to the river and its side creeks to drink. Like the people at

Dome, those from Yeran village say that the mine's impact has left them hungry. I was also told that people there were becoming very thin, and that some adults were greying prematurely.

The people I met with also said that the mine should not have begun production until the tailings could have been dealt with safely; they say that pollution has already 'spoiled' their land. They do not want OTML to close down and leave the country, because they want the mine to pay them compensation for damages already incurred.

While the projects that OTML (i.e. the Trust) provides are helpful, they are considered insufficient as compensation for the mine's impact on their environment. They want projects that will help them increase local food production, but they also want to ensure that they will receive proper instruction and support for the projects; they recognise that training and assistance are essential for any project to succeed.

Bongabun Village

Bongabun (1980 population, 44; latest count, 56) is only twenty-five minutes walking distance from Atkamba. In fact, Bongabun operates largely as an outlying community of Atkamba. Even the man who owns the land on which Bongabun is built lives in Atkamba. Villagers walk to Atkamba to take advantage of its school, church, aid post and trade stores. Land used by Bongabun villagers includes areas on the east bank of the Ok Tedi, which Awin landowners have given them permission to use. There is one house with an iron roof, one water tank and one motor canoe in the village. They have rubber trees, but do not tap them.

They share the opinions of the Atkamba people regarding the mine's impact on their environment. In addition, they complained that there was an increased incidence of sipoma or grille among their children, and blamed this on contact with the dirty water of the Ok Tedi.

Atkamba Village

Atkamba (1980 population, 247; latest count, 510) is composed of three units, sometimes referred to as the Mission Station, Aran #1 and Aran #2. The village was founded shortly after 1951 by a missionary affiliated with the Asia Pacific Christian Mission (now Evangelical Church of Papua). Previously, the people lived in independent hamlets along the Ok Tedi or between the river and the border. People currently living in the village own land over a widespread area, including the area immediately surrounding the village; along the Ok Tedi both north and south of the village; west of the village as far as the border; west of Komokpin village across the border in Irian Jaya; and along the Muyu River in Irian Jaya. Also, some current residents of Yogi village formerly lived here.

Atkamba is a mission station in decline. It was once home to expatriate missionaries and language workers along with the resources they provided. There is a school at Atkamba. The airstrip is still maintained, but its use has largely been relegated to emergency medical transport. Even then, given the limited availability of Mission Aviation Fellowship aircraft, it is often faster to send patients by outboard canoe to the hospital at Rumginae. People still speak in reverential tones about the days of the early missionaries, but Atkamba no longer has privileged access to outside resources.¹²

Perched on a sun-drenched bend in the river, the village was long ago cleared of its ground cover in order to create the broad vista favoured by expatriate missionaries. The ground on which the village stands has consequently been baked by more than two decades of continuous exposure. The Trust has built a steel bridge over At Creek, which divides the Mission Station from Aran #1 and #2. The creek used to be green and full of fish and prawns; it now runs murky brown from the backflow of the Ok Tedi. River bed aggradation in the Ok Tedi means that, when it floods, the new bridge is submerged and unusable, forcing villagers to maintain a bush material bridge across the creek at a higher point. During floods, villages paddle their canoes between the two parts of the village, a problem they share with villagers at Yeran.

While the people at Atkamba have rubber trees, they are not tapping them because of the low return and the expense of transporting bulky rubber bags to Kiunga. There are eleven houses with iron roofs, six water tanks and twelve motor canoes in the village. They only occasionally sell goods at the market in Kiunga.

One economic legacy of the longstanding missionary presence in the village is the number of people with extensive formal education; my impression is that this translates into larger urban remittances as well. The village also benefits monetarily from occasional ECP programmes held there. Most villagers are devout evangelical Christians. They consider many Yonggom customs to be inappropriate for Christians, or even evil. Of the last ten men from the village to marry, eight married women who were also from Atkamba.

Nearly 600 refugees settled beside Atkamba village in 1984, but they moved to the resettlement centre in Iowara (located in East Awin Census Division) three years later. In the interim, however, they managed to clear large areas of land for their gardens. This land will not be available for new gardens for nearly a decade.

¹² Burton (pers. comm.) has remarked that the situation here is comparable to other places in the district (e.g. Hawenai), where the Health Sub-Centre is not up to staff strength and is functionally little above an ordinary village aid post. The Atkamba Sub-Centre is one of those which King reveals improbably returned 'nil births' in the last reporting period (King 1993, Table B) and of which he says the health statistics are 'almost uniformly worthless' (1993:B1).

The villagers are very upset about the mine's impact on their environment. They told me how the trees are dying, the river banks are eroding, and the currents in the Ok Tedi are rough when the water levels are high. The river is widening and becoming shallow; they find it difficult to paddle a canoe along the river. The grey, sediment-laden water is blamed for sores and grille. People say some sago palms do not produce starch, only a watery substance. The small creeks are being blocked off at their entrance by sediment from the Ok Tedi, and both gardens and tree cover have been lost where sediment has been dumped by floods. The people complain that sweet potatoes and taro grown in gardens near the river do not soften when cooked, but stay hard. They also say that, when banana stalks are covered by floodwaters from the Ok Tedi, the fruits open immediately and spoil. Now that they have to make gardens inland, they complain of an actual shortage of food, and they pointedly asked me who would feed them, because they do not believe they can make ends meet from normal subsistence practices. In part because of the refugees, there is little game in the forest to the west of the village. There are few fish remaining in the creeks and streams. These fish are small and people refuse to eat them because they do not taste good; they have 'no fat' and 'no blood'.

Atkamba villagers do not consider the Trust projects and the VDF money to be sufficient compensation for the damage to their environment. They said that the damage to their environment, to their forests and to their animals was worth much more than what they have been given.

Summary

It would be difficult to exaggerate the magnitude of the problems faced by people living along the lower Ok Tedi. They have a legitimate right to be angry regarding environmental impacts not predicted at the time of the Sixth Supplemental Agreement or in other project documents and, consequently, genuine grounds for discontent at the limited benefits that they have received in return.

As I have noted, the form in which grievances are couched bear a striking resemblance to those expressed by Bougainvilleans in 1988. If similar consequences are to be avoided, *much greater attention must be paid* to the rights and needs of the people living along the Ok Tedi. I need make no judgment or prediction in saying this; I am merely conveying what my informants told me. They will ultimately judge OTML on the extent to which it responds with new policies to safeguard their welfare and protect their environment and resources.

A range of remedial measures will be put forward elsewhere, but of particular note is that health and nutrition problems need investigation, and efforts are urgently required to help subsistence farmers grow more food.

After visiting this zone, it is difficult to believe that the worst is over. There were no clues I could see that the destructive processes now in train will not continue to make their impact felt:

- that all the adjacent lowlands river banks will be covered by mine wastes, resulting in the permanent destruction of all vegetation, including pioneering regrowth;
- that all of the small creeks leading into the Ok Tedi will eventually become clogged with mud, turning into widening swamps; and
- that the entire southern portion of the river corridor, extending up to two or three kilometres to the east and west, will be heavily impacted, with the end result that the Ok Tedi will eventually flow through a dead zone more than thirty kilometres long.

ENVIRONMENTAL IMPACTS: DISCUSSION

How It Once Was

Not many years ago, the Ok Tedi was a lively river, and the trees that lined its verdant banks were populated by numerous species of birds. Travelling by canoe, one would likely encounter tiny emerald kingfishers perched along the river's edge, or see a trio of hornbills balanced high above in the treetops. The noise from the canoe would startle snowy egrets into flight, and one would certainly see pairs of Eclectus parrots flying together, the green-feathered male along with its red-feathered mate. A fortunate traveller might catch a glimpse of a solitary bird of paradise winging past, its tail feathers alight with neon orange or fluorescent red. A Sulphur-Crested Cockatoo perched on a nearby tree might startle the unwary passers-by with its raucous cry.

In the still of the evening, animals would come to the river to drink: tree kangaroos, the possum-like cuscus, bush fowls and bush turkeys, even wild pigs. Cassowaries drank from nearby streams. During dry months, these animals often fell prey to Yonggom snare traps as they came for water.

The river itself was home to numerous varieties of fish; any Yonggom speaker can rattle off dozens of names: *on kirup*, the catfish with razor sharp whiskers, *on awat*, the eel, *on demet*, the barramundi, *on biwin*, *on arok*, *on mitmit* and more. A few old crocodiles patrolled the waters, all that was left from a frenzy of skin-selling during the 1960s. There were small turtles and large tortoises; the latter came to lay their eggs by the dozen on the white sandy beaches along the river. Nearly every villager has stories to tell about night-time excursions to gather turtle eggs in the moonlight.

The trees along the shore provided shade for the animals that came to drink from the river. They attracted birds and other animals to their fruit. They were a source of the cane used to make rope, timber for house building, fibre for weaving mats, bark for cooking containers, and wood for making fires. Canoe

trees, like *at murut* and *at anga*, were particularly valuable, for along the river they grew straight and tall, and it was not too difficult to launch the completed canoe.

Not long ago, the Ok Tedi was a lively river, but today it runs silent and muddied, its banks lined with bare, defoliated trees: a winter landscape in the tropics.

Key Environmental Issues

The complete understanding of an environmental system must include the actions and requirements of its human inhabitants. *Human ecology* focuses on the interaction between people and their natural environment. It examines human resource use and the relationship between technology, subsistence strategies and natural biota. For example, human ecologists might study how Yonggom gardening techniques, including slash-and-burn horticulture, relatively small and separated garden plots, multi-cropping within a single garden, and long period of fallow all facilitate rain forest regrowth. From this position, it is recognised that people are a central part of the ecosystem in which they participate. Therefore, from the perspective of human ecology, questions about environmental impact emphasise the consequences of different policies or practices for the members of local communities. In the following sections of this report, I consider the major issues in human ecology that are raised by the mine's impact on the Ok Tedi and Fly River ecosystems.

As the village case studies indicate, there are a number of problems facing people throughout the region. In terms of the mine's impact on food production, the reduced numbers and size of the fish in the rivers and creeks means a diminished fish catch. There has been extensive loss of crops, as well as loss of fertile river land, through overbank deposition of mine wastes. Sago stands along the river have been damaged, as well as some trees away from the river. Villagers also expressed concern about the impact of mine wastes and high rates of sedimentation on the region's extensive system of creeks and swamps.

Deforestation

The most serious ecological problem is overbank sedimentation along the lower Ok Tedi. A provisional quantitative estimate is that 30 km² of rainforest along the lower Ok Tedi has been damaged (BHP Minerals 1991:45; cf. Duff 1992). There is also wide dispersal of mine wastes into the feeder streams leading into the Ok Tedi, resulting in localised deforestation of areas as far as three to four kilometres from the river, as is the case along creeks flowing into the Ok Tedi south of Dome, and two or three kilometres up the Ok Mart River. Along the Fly River below D'Albertis Junction, villagers at Erehta report that flood waters loaded with mine wastes back up along the Ok Yimbusi, and that the trees along the Fly near their village are showing signs of stress and that their leaves are yellowing.



The sources I have quoted, and the opinions I have heard, differ on the physical extent of deforestation along the lower Ok Tedi. The discrepancies indicate that the problem was not addressed systematically as soon as it became obvious that damage was occurring.¹³ There are estimates, but little hard data, concerning the extent to which mine-derived sedimentation may be found upstream along the Ok Tedi tributaries. Too little is known about future impacts.

It is clear that, without a change in the method of tailings disposal, the southern stretch of the Ok Tedi may well become an unrecoverable dead zone, several kilometres in width, over the next five to ten years. Efforts to monitor the impact of mine wastes on adjacent land must be stepped up, and new options put forward for reducing the load of mine wastes that is currently transported by the Ok Tedi. I also support plans to investigate the potential for rehabilitating impacted areas.

Loss of Fish

Environmental monitoring shows that there was a decline in the number, biomass and species diversity of fish caught in gill nets in the Ok Tedi at Ningerum and Atkamba soon after mining started in the 1980s (Smith 1988:3, Figs.7a-7d, Figs.8a-8d). In 1992, fish abundance at the two places was described as 'very low' and as having 'continued to decline' respectively (Smith et al. 1992). The loss of fish is obvious to Yonggom informants.

Other possible changes are not so clear-cut. Local people are concerned about the potential health risks associated with consumption of fish from the Ok Tedi and Fly rivers. As seen above, informants commonly link river pollution with skin disorders, persistent sores, illness and birth defects. The consumption of fish from the river is viewed in the same light, as is the reported discovery of fish in the Ok Tedi with skin ulcers or 'copper rocks' in their stomachs. At best, fish 'taste bad', have 'no fat' or 'no blood'. Villagers are suspicious of, and cannot easily judge, assurances of safety made by OTML Environment Department staff. Part of the problem is that they feel that they lack access to a reliable source of information to help them make such an assessment.

Another issue is the protection of remaining fish populations. Villagers report that there are small fish kills in the rivers from time to time (not to be confused with the large kill in the Ok Tedi in June 1984). Some dead fish could be attributed to infrequently monitored gill nets. For example, I saw decomposing fish floating close to a net that had been set on the Ok King at Moian. Finally, after periods of drought in this region, the decomposition of vegetation covered by rising rivers depletes the water's supply of oxygen, resulting in natural fish kills when the anoxic water enters another system. A large natural fish kill of this type in the Middle Fly was reported at Obo in April

¹³ Recently completed air photography should help in the assessment.

1988 (OTML 1988b:4). Nonetheless, the exaggerated sediment load carried by the river remains the greatest threat to fish in the Ok Tedi and Fly rivers.

The Yonggom reject the widespread use of gill-netting for commercial fishing operations, and in some places for local consumption as well, because of its potentially harmful effects on fish populations. Furthermore, some people have been counselled by their leaders not to fish using derris root, a local poison, for the same reason. Many of the people living in the area are afraid to eat fish from the river because of their concerns about the possible impact on their health.

Turtles

Informants report a decline in the number of turtles in the Ok Tedi and Fly rivers. High levels of suspended sediment, habitat change, increased motor traffic along the river corridors (both commercial and private), and increased hunting during the 1980s may all have played a part in this.

Swamps and Streams

Riverbed aggradation, high levels of sedimentation, and the deposition of mine waste have affected the local system of swamps and streams: Mine wastes move upstream into this wetland system when water levels in the Ok Tedi are high, sometimes for a distance of several kilometres along the meandering streams. While lowland rainforests are among the most diverse ecologies in the world, from the perspective of human ecology, it is the adjacent swamps that are most important in terms of food production. Starch from sago palms, which only grow in swampy areas, is the mainstay of Yonggom diets. Prawns and small fish that are caught in these swamps and streams provide important protein. The rich, decaying vegetative matter in the swamps supports all manner of animal life in the adjacent forest.

Many of these swamps, which used to exit into the Ok Tedi, are now being affected by riverbed aggradation and overbank sedimentation, which block up and prevent the swamps from draining. The consequence is that water levels rise, affecting plants and trees, including sago palms, that grow in the swamps. Other new sand banks block creeks or streams, which causes water to back up and spread out, creating new swamps.

In connection with this, changes to the configuration and extent of swamplands may also alter mosquito breeding patterns. Very high levels of filariasis infections — a disease with a mosquito-borne vector — were recently recorded at the Rumginae hospital (Turner 1991:5) on the edge of the study area; any environmental change that may help mosquitoes infect humans is unwelcome here.

Riverine Gardens

Jackson (1979:7) wrote that the Yonggom 'used the seasonal flood lands of the rivers for bananas and sugarcane cultivation'. These flood plains were the most fertile of Yonggom land because of the rich soil carried downstream from the mountains. Rainforest gardens made using traditional subsistence techniques generally bear one good crop of bananas, which is the most important Yonggom foodstuff after sago, and a mediocre second crop. In contrast, riverine gardens produce two and sometimes three good harvests. Equally important, the variety of food crops that will thrive on the river soils is far greater than the few that do reasonably well inland. The dry land soils are so poor here, as generally elsewhere in the North Fly, that it is not only a question of yields in relation to labour inputs, but also of whether the inland soils will actually grow the supplementary crops — greens, corn, sweet potato, etc. — that can turn a poor, monotonous diet into a balanced, adequate one.

Without access to riverine garden land, the Yonggom have had no choice but to turn their attentions inland. This is exacerbated by the presence of the refugees, and a recurrent complaint is that of food shortages and actual hunger.

Because environmental damage has reduced the land available along the Ok Tedi, extra pressure has been placed on garden land close to the villages. When gardens are more distant, this has the familiar effect (Rappaport 1971:127; Ellen 1982:147) of increasing transport costs as a part of the overall subsistence effort. Given that bananas, the main garden crop, are heavy and bulky, and that women are principally responsible for carrying food back to the family house (as well as subsistence tasks in the garden and processing sago), the added burden is almost wholly borne by them.

Sago Palms

The starch extracted from sago palms is the most important traditional staple in the area, yet there has been no research that gauges the impact of mine wastes and increased sedimentation on these swamp-dwelling palms.

As trees appear to be suffering stress resulting from anoxic conditions caused by the deposition of heavy layers of sediment (Duff 1992), the presence of mine waste in the swamps may also disrupt the normal flow of nutrients to the sago palms. Other sago palms are located in swamps whose outlets have been blocked by sedimentation; permanently elevated water levels in these areas may be affecting the trees. It may also be that variations in the levels of major and trace minerals available to the palm affects its maturation process. The possible effects of the mine on riverine and backwater sago stands is really unknown.

Villagers throughout the impact area claimed that there has been an increase in the failure of sago palms to produce edible starch upon maturity. I should say that the Yonggom are very sensitive observers of sago ecology, as well might be expected given the survival value that this knowledge confers. As I have

indicated, however, not enough is known at this stage for simple conclusions to be drawn. Future research to answer these questions is imperative.

Hydrology

There have been significant changes in the morphology of the Ok Tedi channel since production at the mine began. The river has become shallower and wider. When the water level is low, the exposed sand banks make the river nearly impassable. When the water level is high, the currents are quite strong, making the river dangerous to travel. Flash floods are particularly dangerous for canoes. River travel is increasingly impractical, impeding the transport of goods and people, and the delivery of medical services. Even casual river crossings to hunting land, to garden land, to sago stands, or to the Kiunga-Tabubil highway, have become dangerous as a result of the intensified pattern of flooding.

Given the very flat terrain, the flood plain of the Ok Tedi is quite broad. As a consequence, when the river floods, mine wastes are widely distributed. While aggradation of the riverbed — of about two metres — was predicted for the lower Ok Tedi in 1988,¹⁴ overbank flooding and the deposition of sediment does *not* seem to have been foreseen, and the focus was on what might happen below Kuambit, not above it, where the current damage is most serious:

Severe aggradation is predicted at Konkonda/Atkamba ... The predicted aggradation at Kuambit, while probably not severe enough to cause a *channel avulsion*, is high enough to suggest that navigation problems could arise (OTML 1988:36; my italics).

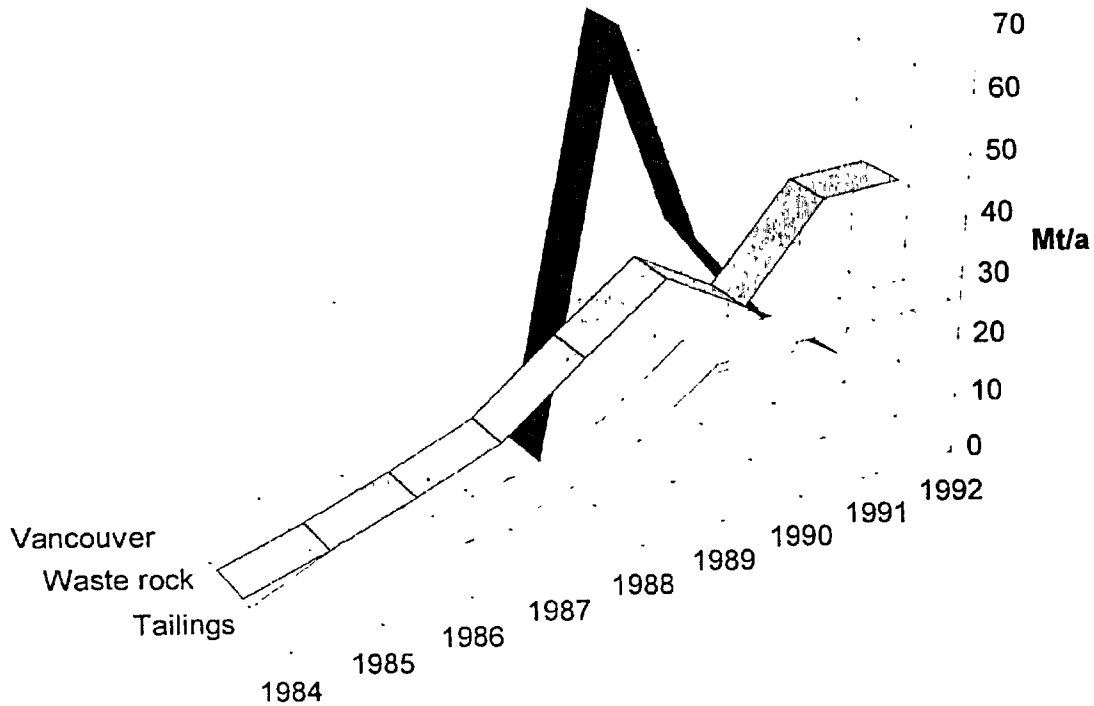
The emphasised phrase carries the specific meaning that the river would not rise above bank level and spill over its flood plain at Kuambit. As there are no other references to 'channel avulsion', I assume that this was considered to be *even less likely* elsewhere along the Ok Tedi River.

With 'channel avulsion' dismissed as a likely scenario, the question of ecological damage to land and swamp resources was not addressed. Villagers were originally told in publicity material that their land and wildlife would be quite safe (e.g. OTML 1984:3), but when this could no longer be guaranteed, equally frank warnings of the dangers to them were not issued in the same format. Finally, when flooding was immanent, measures were not taken to mitigate the damage to forests that lined the river.

The amounts of tailings and waste rock from the mine and from the 1989 Vancouver landslide entering the Ok Tedi since production started are shown in Figure 2. Although new inputs of Vancouver material to the system will by now have dwindled to a background level, inputs made in past years, together with coarse materials eroded from the waste rock dumps, still lie in the channel of the Ok Tedi, raising its bed.

¹⁴ A revised estimate puts the peak at 3.5 m (Markham 1991, Table 3.5).

Figure 2: Annual volume of various materials entering the Ok Tedi since the start of mining.



Source: OTML hydrology reports and Sixth Supplemental Agreement.

Finer material and ore process residues are transported as suspended load and pass through the river system in normal conditions. However, the riverbed aggradation now seen along the Ok Tedi means that the shallower channel cannot cope with flood events, and significant overbank flow will continue to occur until either the banks are considerably higher than they are now, or until the river channel has had a chance to degrade again.

Exactly when the first instances of garden damage occurred does not seem to be documented. Nevertheless, colour photographs in an environmental report taken from the air in June and October 1987 (Ok Tedi Mining Limited 1987, Plates 6 and 7) show the exact spot south of Bige to which I was taken by helicopter on 14 August 1992 with Ian Wood and John Burton. Forest damage is not evident at this time. A photograph taken upstream at Ningerum (Ok Tedi Mining Limited 1987, Plate 9) shows the now inundated Alice Farm to be intact. The dates of these photographs coincide with the beginning of my main doctoral fieldwork, from September 1987 to May 1989. But at the end of this period I wrote that

... sediment is being deposited along the riverbanks, forming five and ten metres-wide stretches of knee-deep mud. After a heavy rain in the mountains, the Ok Tedi overflows its banks, depositing waste sediment along what was the most fertile area for gardens, the shoreline (Kirsch 1989:56).

Given that I was writing some four months prior to the Vancouver landslide (see Figure 2), the sediment that I saw was not landslide debris, but mine-derived waste. My descriptions thus place the main onset of damage to 1988 and early 1989.

Local Interpretations of Environmental Impact

The Yonggom regard the mine's environmental policies and its impact on their environment as being similar to sorcery and its harmful effects. Both are perceived as irrational, and both are considered to pose a threat to human life. Illness, injury and accidents that would have been attributed to sorcery in the past are increasingly accounted for in terms of the mine's impact on the local environment. The Yonggom use ideas about sorcery to explain pollution and to challenge the environmental policies of OTML. Let me illustrate this argument with three case studies.

Case Study #1: The loss of a finger.

One day in June of 1992, Awi Dowon went by canoe to Ok Kobom, a heavily silted creek south of Dome village, to fish. He caught a catfish (*on kirup*), but cut his finger on one of its sharp whiskers. He paddled his canoe home to Dome and his hand got wet along the way. When this happened, Awi later concluded, the 'copper *marasin*' in the Ok Tedi infected his finger. Two days later, the finger began to throb and the pain continued unabated for nearly two weeks, when the finger began to swell. Awi consulted the medical orderly in the village, but treatment was unsuccessful and he was transferred to Rumginae, where an operation to amputate his finger had been scheduled. According to Dr Fitzmaurice, the attending physician, the toxin from the catfish spine caused necrosis in the lower tendons of the finger. It was an unusual occurrence, but not without precedent. Awi Dowon, however, said that he had been poisoned by the mine.

Case Study #2: A broken leg.

Ketop Negat from Yeran village was chopping up a dead sago palm beside Ok Kobom, looking for beetle larvae to use as fishing bait. He decided to cut down a mature palm and to return later to shoot any wild pigs that might come to feed on its starch. He was standing knee deep in silt when the tree unexpectedly started falling towards him; he tried to move out of the way, but was not fast enough. The tree struck him below the waist, breaking his leg. According to Alex Maun, Negat would not have been fishing near Ok Kobom but for the mine. Since people are reluctant to fish in the Ok Tedi, they now have to travel greater distances to find food, which exposes them to new dangers. According to Negat's wife, the mud in which he was standing — sediment from the mine transported upstream when the Ok Tedi is

flooding — prevented him from moving out of harm's way. Maun and Negat's wife agree that the mine is responsible for the broken leg.

Case Study #3: An overturned canoe and a drowning.

Late one afternoon in 1987, a motor canoe travelling from Kiunga overturned in the strong currents at the junction of the Ok Tedi and the Fly rivers. Three people drowned. On 24 January 1988, I attended a meeting in Kiunga regarding compensation payments for one of the deaths. At that meeting, it was hypothesised that the sons of the deceased might be partially to blame for their father's death. They both had reputations for fighting and causing trouble; it was suggested that someone angry with one of the sons sought revenge against the father. This seemed to quiet the man's family, who accepted the canoe owner's offer of compensation.

As I have described elsewhere at length (Kirsch 1991), discussions of this nature among the Yonggom do not usually result in consensus. Instead, such discussions generally produce ambiguous results, which act to forestall violent acts of reprisal against persons suspected of sorcery. Opinions about the responsibility for acts of sorcery are often revised as new information comes to light. In this case, while the behaviour of the sons was mentioned as a possible motive for the sorcery that caused their father's death, the final determination of responsibility was left pending.

When I returned in 1992, Case #3 had been 're-opened'. In discussions in Kiunga, I was told that the canoe owner planned to seek compensation from OTML for the death of the passengers travelling in his canoe. The mine has changed the morphology of the river, making it dangerous to travel by canoe; this is the current explanation given for the canoe accident.

Misfortune from Sorcery as a Model for Environmental Impact

What do these three examples have in common? In each case, the proximate cause of the mishap — the wound from the catfish spine, the collapse of a tree in an unexpected direction, and the strong currents at a river junction — is recognised by those involved. There is no struggle to account for *what* has happened. But following the basic paradigm for sorcery, in which misfortune is brought about by the actions of persons, rather than the product of chance or the result of natural forces alone, they are trying to discover *who* is responsible. This is the point at which scientific explanations and belief in sorcery diverge.

What is the relationship between sorcery beliefs and assertions about the mine's responsibility for these mishaps? Let me first examine the terms that the Yonggom use to describe the mine's impact on their environment.¹⁵ Based on conversations in the Yonggom language, the most commonly used term is *moraron*, which means 'spoiled', 'rotten', or 'corroded', as of food that has gone bad or wood that has rotted. Another frequently used term is the Motu

¹⁵ The Yonggom are at the confluence of three trade languages — Motu, Malay, and Pidgin English — from which they borrow freely in everyday speech.

muramura, which means ‘medicine’ and, by extension, it probably refers to chemicals in general. A third term is the English and Pidgin phrase ‘copper *marasin*’. *Marasin* has the same meaning as *muramura*, which is to say, chemicals with potentially beneficial or harmful effects. As Burton (1993:2) points out, people use the phrase ‘copper *marasin*’ to refer to harmful, although not necessarily visible, effects of chemicals used by the mine. Another term employed in a similar fashion is the English ‘power’. Finally, the Yonggom use the English terms ‘chemical’ and ‘poison’ in the standard way, as well as ‘pollution’ and ‘environment’, neither of which were part of village vernacular until quite recently.

Not once did I hear the Yonggom use the terms *bom*, *mirim*, *kumka*, or *kuman*, the Yonggom names for different kinds of sorcery, in reference to the mine’s impact on their environment. In other words, the terms used to refer to the effects of the mine are *not* the same as those used to describe acts of sorcery. Furthermore, none of the terms discussed above have any ‘mystical’ or ‘metaphysical’ implications; they refer to physical or chemical effects (cf. Burton 1993a:3). The Yonggom therefore do *not* confuse the impact of the mine with sorcery. The last case study demonstrates this unequivocally.

Case #4: Death by assault sorcery.

Wurin Maun of Yeran village had to walk seven kilometres from his village in search of prawns. Alone in the rain forest, he was attacked by an assault sorcerer, what the Yonggom call a *kuman*. His body was not found for several days. None of this, according to his nephew Alex Maun, would have happened were it not for the mine’s impact on local resources, which forced Wurin to go further away from the village than usual for food.

In this case, the proximate cause of the death was attributed to sorcery, but the mine was still considered responsible. The key here is that the mine’s role in the event was clearly differentiated from the act of sorcery. Sorcery accusations have become the Yonggom model for holding the mine responsible for its environmental impact.

To the Yonggom, equality in exchange, or reciprocity, is the basis of human relationships. A sorcerer is someone who violates this premise and, turning to evil, deliberately brings about harm to others. Sorcery accusations hold people accountable for their behaviour; they are a form of social control. A sorcery accusation brings two things together like cause and effect: a person who has been behaving inappropriately and some kind of loss or mishap. Similarly, when the Yonggom pair instances of misfortune with environmental changes wrought by the mine, they are attempting to hold OTML accountable for its impact on their environment.

Regarding Environmental Decline

How does one account for perceptions that the overall fertility and productivity of nature have been diminished by the mine? There are a number of physical

reasons why the land surrounding Yonggom villages may be less productive than in the past. First, the pattern of relatively large and permanent settlements is new among the Yonggom. Most of these villages were established about thirty years ago, and continuous use of adjacent resources may be taking its toll, particularly given traditional subsistence techniques, which make extensive use of land through slash-and-burn horticulture. Second, the refugees, who exploit an overlapping set of resources, have more than doubled the number of people living off the land in this region.

Psychologically, the economic position of villagers with respect to the relative affluence of Kiunga or Tabubil leads to a profound sense of underdevelopment, which can be added to the physical pressure on resources. The potential returns from cash-cropping compare poorly to regular wages or what may be imagined as the large incomes of local businesses. It is not difficult to see that people in the bush have greater expectations than what their current circumstances will allow them to achieve.

The transformation of local landscapes has greatly disturbed the Yonggom. Roy Wagner (1981:31) has said that anthropology and so-called 'cargo cults' among Melanesians are both attempts to make sense of the other's culture. In much the same way, what the Yonggom have to say about the declining fertility and productivity of their land is their version of an environmental impact report, emphasising the traumatic impact of the mine on their land and resources.

Comparisons between Bougainville and Ok Tedi

There are striking similarities between written complaints about the environmental impact of the Ok Tedi Mine and concerns expressed by Panguna landowners in Bougainville shortly before that dispute became violent. In 1988, a petition from Dome village was sent to the North Fly Area Coordinator, claiming that:

When the Ok Tedi copper mine became operational in 1981, it harmed all of the living things along the river and the riverbanks; it began killing all of the animals and plants.

Now our environment is completely destroyed. Everything is lost forever. The mine wastes and tailings dumped into the river at the mine site have left the environment in very poor condition.

This has affected the fish, prawns, crocodiles and turtles in the river — they are almost completely gone. Our gardens along the river were ruined by the mud and by the 'copper medicine' dumped into the river by the mine.¹⁶

A letter written by the people in Kungim village to OTML management in Tabubil expressed even more sweeping concerns about the mine's environmental impact:

¹⁶ See Kirsch 1992, Appendix 4. The original text has been edited for presentation.

All of these things show evidence of the mine's impact: Our garden crops, dogs, pigs, fish and even people becoming ill. Coconut trees have died. People are suffering from sores. Even our staple food sago is affected. The rain makes us sick. The air we breathe leaves us short of breath. And the sun now burns our skin.

In the past, everything was fine. We never experienced problems like these before. But in the ten years that OTML has been in operation, all of these changes and more have taken place. Other plants in our gardens have been affected as well. We are concerned about these changes and it seems reasonable to assume that they are signs of the impact of the Ok Tedi mine.

Based on the experience of village elders, these things have been caused by the mine. Our lifestyle has changed completely. Everything along the Fly River and the Ok Tedi has been affected.¹⁷

Compare these Yonggom concerns to the views expressed in a submission made to an environmental review team by Francis Ona, then Secretary of the Panguna Landowners Association. Ona identified the following problems, which he attributed to the Bougainville copper mine:

Crops: increase of disease; shorter life-spans; lower yields; leaves bear rectangular markings.

Plants: trees are dying near the mine and road; unknown pollutants have affected cocoa trees; introduced plant species have colonised the area; unregulated harvest of trees for timber.

Soil: frequent landslides near the mine; one-fifth of the area has become barren; the soils have been poisoned by run-off; soil fertility has declined; the creeks bear a heavy load of minerals; the mouth of the Jaba River at Empress Augusta Bay has silted up.

Rivers: reduction in fish population; fish are not edible because of mineral contamination; other creeks have disappeared because of pit drainage; people cannot bathe in the rivers because of the pollution.

Air: the air is polluted by the burning of tyres; the process plant releases pollution into the air; fumes, dust and debris from blasting pollutes the air; industrial pollutants are also released into the air by the mine. Aerial spraying carried out by BCL from 1968-69 was the starting point of environmental problems for plants and trees.

People: chronic illness has affected many people; people also suffer from rashes and sores caused by pollution.

Animals: birds are affected by unknown diseases; the flying foxes are dying; the fish have sores on their bodies, have no eyes and are dying for no apparent reason; wildlife throughout the impact area are disappearing as well, including birds, pigs and other animals.¹⁸

¹⁷ See Kirsch 1992, Appendix 3. The original text has been edited for presentation.

¹⁸ See Applied Geology Associates 1989, Appendix VI, and Kirsch 1992, Appendix 5. The original text has been edited for presentation.

Local people's shared concerns about the environmental impact of the two copper mines range from garden and tree crops to fish and game, to their changing landscapes, and to the very air that they breathe. Their wide-ranging complaints about environmental degradation and the negative consequences of pollution from the mine on human populations are strikingly similar.

When studying environmental impact from a scientific perspective, one is encouraged to look for changes in biota that can be quantified or measured. In economic terms, one defines the natural environment in terms of resources that have a specific value as commodities, i.e. things that can be bought and sold. Neither of these perspectives on nature comes close to the 'Melanesian Way' that Bernard Narokobi (1980) has described. The complaint that there are no more flying foxes on Bougainville, or that no birds fly along the Ok Tedi, are not simply references to a change in species composition or to economic loss; in both cases the losses are also symbolic of the way in which their environments are being transformed by mining operations.¹⁹ In order to bridge the gap between corporate and local perceptions, these claims must be seen for what they are: criticisms of the impact that mining operations have had on their environment.

There is no easy response to assertions about generalised environmental degradation, nor do I have any specific recommendations to make. The basic propositions emphasised throughout this report are appropriate as general guidelines here as well:

- the need for open and effective communication between the mine and the affected parties;
- that independent assessment of the mine's environmental impact be carried out;
- that the findings of this research be communicated to the people living in the impact zone; and
- that just and reasonable compensation be paid for the mine's impact on their environment and resources.

Ultimately, however, concerns about the environment will never be fully resolved without real change in the mine's impact.

COMMUNITY DEVELOPMENT ISSUES

Cash Crops

According to Jackson (1979:7), there have been experiments with a number of cash crops in the Kiunga area, including coconuts, chillies, peanuts, vanilla and pepper. Rice was tried in Moian in 1958, but yields are said to have been poor.

¹⁹ *Contra* Burton (1991:25)

Coffee showed some promise during trials, but quarantine regulations protecting the highlands coffee industry prevented expansion. Apparently, cloves and nutmeg, which Jackson says are grown under similar conditions west of the border, have never been tried in Western Province.

However, the fact that a small pilot project failed in a previous decade does not necessarily mean that the crop is unsuitable for growth or sale. There are new varieties of commercial plants that are more resistant to disease, better suited to a range of environmental conditions, and which produce greater yields. There are new technologies for growing and harvesting various plant products and tree crops. In addition, the transportation network in the province has grown tremendously in the last decade. In particular, any potential export crop could take advantage of cargo ships that regularly supply Kiunga but return to Port Moresby virtually empty.

Okari Nuts as a Potential Cash Crop

An okari nut (*Terminalia* sp.) cash crop project is being tried on the Managalas Plateau in Oro Province (Michael Bourke, pers. comm.) while another nut, galip (*Canarium* sp.), may have potential in the Solomon Islands (Evans 1993). Okari has been considered by the Department of Primary Industry in Western Province since 1984. One problem that needs to be solved is how to preserve the nuts; can they be roasted like peanuts? Most trees are currently planted in old garden sites; okari trees are not numerous in the primary rain forest. Therefore, production would require planting more trees, which is somewhat problematic given the long start-up period (approximately seven years until they bear a full crop) and the seasonality of the crop (bi-annual fruiting). Nonetheless, okari nuts remain an intriguing possibility for development.

The main market would be expected to be local, but there may be export potential as well. The best way to evaluate sales would be to test market the nuts to expatriates and Papua New Guineans in Tabubil. Brazilian rainforest nuts and nut products — e.g., brittle, candy bars, ingredients in ice cream — are marketed in the United States as 'green' or 'environmentally friendly' and have had considerable success. It might be possible to create a similar market niche for okari nuts in Australia.

Rubber

In 1979, Jackson asked the following question:

What has gone wrong? Tappable rubber is untapped; yields are rather low; production is only one-tenth of that forecast; fewer than a dozen villages are actually earning income from rubber (Jackson 1979:8-9).

Jackson hypothesised that expectations for participation in, and profit from, the Ok Tedi mine discouraged local rubber production. Fourteen years later, not many people from the area are employed by the mine overall and village-based rubber production continues to decline.

Of the eighteen villages in the area that I surveyed, only people at Bige (and Dome, rarely) currently tap their rubber trees and bring the rubber to Kiunga. The people say the return is too low. The basic price for cup-lump rubber in Western Province is 18 toea per kilo, according to Babalema Kalama, the Provincial Rubber Coordinator in Daru (John Burton, pers. comm.), to which may be added a possible subsidy, but from which must then be subtracted the cost, at about K4 a bag, of transport to Kiunga. A 50 kg bag is worth only K5 at this rate. Higher figures may be quoted, but even at K12-15 per bag, the viability of rubber is suspect. Mr Kalama concludes his report for 1991 with this dismal assessment:

It is well noted that 1991 was once again an unsuccessful year for [the] rubber industry in the province...

Problems contributing to very poor output were lack of financial back up to rubber extension programmes, lack of project reviews and poor reporting systems, isolation of smallholders and of course the low farm-gate prices (Kalama 1992:9).

Total provincial production in 1991 was 124 tonnes, worth K22,346 at 18t/kg. The Kiunga District had a 19.6 percent share, worth K4345.92 at 18t/kg. More than 6000 people living in the Kiunga District villages have rubber plantings, so the return per head is now *less than K1 a year*.

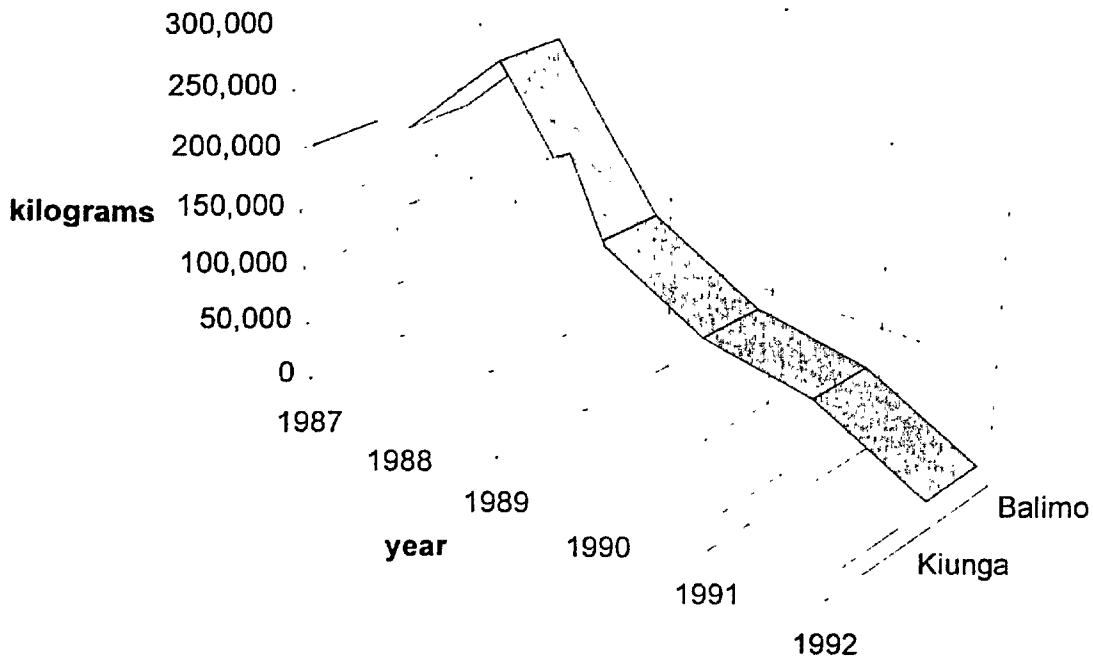
A recent consultancy report for the Asian Development Bank (Agricultural Development Services 1992) presents grower returns for Atkamba village (Table 4). The village was noted as having had strong production between 1985 and 1988, which was generally attributed to the good prices during that period, but no production at all from 1990. The collapse of production was blamed on the sharp drop in price after 1988 and the concurrent cessation of buying trips by the Progress Company. In production years, fewer sales were made compared to other rubber growing areas, due to Atkamba's isolation. In 1985, the whole year's production of 23 tonnes (more than the whole of Kiunga District for 1991) was bought by the Progress Company on a single visit, whereas in 1988, a year of high prices, about 45 percent of production was taken to Kiunga for sale. The peak price of 30t/kg in 1988 coincides with the highest levels of production in the district (Figure 3). Price emerges as the main determinant of output per grower.

Table 4: Atkamba village, rubber purchases in selected years 1985-1991.

	1985	1988	1990	1991
Number of growers	39	39	39	39
Number of producers	39	39	10	-
Total sales	22,993 kg	38,710 kg	2,754 kg	-
Value	K4,604.00	K11,463.00	K551.00	-
Price	20t/kg	30t/kg	20t/kg	20t/kg
Average income per producer	K118.05	K293.92	K55.10	-

Source: Agricultural Development Services 1992: Table 3.11 (courtesy R.M. Bourke).

Figure 3: Rubber production 1987-92 in the two most productive districts of Western Province, Balimo and Kiunga.



Source: Kalama 1992, Appendix C. Data for 1992 are Jan-June x 2.

More generally, it is not entirely clear whether rubber is an appropriate cash crop for the area. Given the distances between rural communities and Kiunga, and the difficult terrain, even with improvements in transportation, it makes more sense to emphasise cash crops which have a high yield by weight and volume. Rubber is the opposite, producing a very small yield per pound. Apart from relatively dispersed production of rubber in the Amazon, facilitated by its canal-like network of feeder creeks and streams, nearly all rubber production in the world today is carried out in large, commercial plantations. I am unsure of the source of confidence that Western Province can buck the trend.²⁰

The main proposal for rubber that will affect Yonggom growers is the planned processing factory at Kiunga — a joint venture between the existing Kiunga-based buyers, the Progress Company, and the Trust. It may be that

²⁰ Mr Kalama's report also includes planting and production projections for the years 1992-1996. Writing in January 1992, his production estimate for Kiunga for 1992 is 500 tonnes (of a total provincial production of 1,500 tonnes), roughly twenty times the yield of the previous year.

better prices will be offered to growers once the factory opens and transport problems are solved. Nevertheless, even if transport receives a 100 percent subsidy, it is not clear, on the basis of the evidence presented above, whether rubber can be a successful cash crop if the price stays below 30t/kg.²¹

It would be a mistake to think that even reasonable prices and a local factory would solve all the industry's problems in Western Province. Present extension efforts are poor, with a small annual budget for rubber extension. Rubber has limited potential in the absence of a properly functioning extension service, staffed with officers who receive regular in-service training and who are properly equipped to do their jobs.

Opportunities for Improved Health Care

The medical centres nearest to Yonggom villages are the Rumginae and Kiunga hospitals; I interviewed Dr Mark Fitzmaurice at Rumginae. Obviously, the Yonggom have benefited significantly from medical treatment, but they also now suffer from introduced diseases as well (Maddocks 1975; cf. Denoon 1989). Tuberculosis is so prevalent that everyone in the region may show its symptoms at some point during their lifetime (Mark Fitzmaurice, pers. comm.). Epidemics of influenza threaten the lives of the young and the elderly, and polio is still a problem.

Other health threats are malaria, pneumonia, chronic coughs, diarrhoea, sores and infections, intestinal parasites and filariasis (cf. Taukuro and Nurse 1978-9; Nurse 1990). A key health issue is the cumulative threat to health from multiple infections. This has an impact on childhood growth and development; general health status, including the quality of life and stamina of the individual; reproductive health; outcome or response to morbidity (other ailments); and mortality rates.

The most important factor in improving health has been the development of transportation infrastructure, virtually all of which is directly or indirectly attributable to the mine. However, one weakness in the system is the lack of emergency medical transport. In some cases, distance is the limiting factor, as at Erehta village; in others, along the lower Ok Tedi, river travel is difficult when the water levels are low and dangerous when they are high. Air transport is expensive, not always available at call,²² and not all strips are safe for use. The construction of new roads into the lower Ok Tedi area and between its villages, as currently planned, will be a big improvement.

Another area with room for improvement is in maternal and child health care, notably safety in delivery and child immunisation. There are no traditional birth attendants in the area. Pregnant women are usually assisted by their

²¹ Further analysis of rubber price sensitivity may be found in Burton's report (1993b).

²² A man died of snakebite at Kungim shortly after my visit. The (Catholic) mission pilot was absent from the province at the time.

mothers and sisters, who may not have special skills as midwives.²³ Husbands often veto assistance offered by male health care workers, and women frequently go off into forest camps in order to deliver, further removing themselves from emergency health care. Women at high risk, especially those who have previously had multiple births, are least likely to seek assistance. As OTML health personnel are readily aware, government Maternal and Child Health (MCH) patrols have virtually ceased in the North Fly (cf. Spicer 1991:6) and no rural immunisations have taken place recently. The MCH clinic system *must* be resurrected.

A third area of concern is nutrition. The people in the area have a diet that has traditionally been deficient in protein. Throughout Papua New Guinea, loss of subsistence resources may be compensated for by a higher consumption of store-bought foods. But Yonggom villagers simply do not have the cash incomes that would allow this, and supplementary protein (e.g. in canned fish) is *not equitably distributed* throughout the population. As already discussed, many villages report hunger, and in one place they said that people were growing thin; I take this as a reliable warning that protein malnutrition along the lower Ok Tedi has become a real concern since my original field research in 1987-89.

Cultural Heritage

It is natural that changing conditions, new opportunities, and exposure to new ideas will lead to culture change. Such change, however, can take place at such an accelerated rate, or with such intensity, that unnecessary loss and destruction result. The study of culture change in Papua New Guinea has shown that these losses are frequently regretted later on, as revival movements struggle to reclaim what has been forgotten or destroyed, whether religious traditions (e.g. Fortune 1935 on Manus), genres of artistic production (e.g. Crawford 1981 on Balimo), or historical knowledge. Programmes that support cultural heritage are therefore not intended to prevent or even discourage change, but rather to preserve knowledge about culture and history for future generations. Indeed, one of the goals of anthropology within Papua New Guinea has been to help develop a permanent 'cultural record' (Strathern 1983). Support for local activities that communicate and preserve knowledge of local culture and history, such as local museums and school programmes, have also been effective in this regard.

It is important to note, however, that different strategies must be employed in the villages ministered by the two main churches in the region, the Montfort Catholic Mission and the Evangelical Church of Papua. In ECP villages, people have stopped participating in traditional ritual practices such as sorcery divinations, even though belief in sorcery often persists. In addition, these villagers no longer practice the arts of self-decoration that used to accompany ceremonies and dances. Even though the majority of men over twenty-five have previously taken part in male cult ceremonies, these practices are increasingly

²³ A program to train women from the villages in midwife skills might prove effective here (see McClain 1981, WHO 1979).

disparaged. Given that regional pig feasts held by the Yonggom are probably more important as exchange events than sacred ceremonies, ECP members still attend, even if 'only to eat pork'. Cultural heritage programmes in ECP villages should probably avoid material that would contravene the teachings of the church.

On the other hand, in Catholic villages, or among Catholic villagers, traditional religious beliefs and practices coexist comfortably with participation in the church. Here there is a wider range of practices that might be included in cultural heritage activities.

I propose an effort, perhaps tied in with literacy programmes, primary school curricula and the regional high school in Kiunga, to record and preserve secular tradition and oral history. In practical terms, the main option is to make use of professionals at the existing national institutions, by offering grants-in-aid for field collections and the development of written materials. The most important institutions are the National Museum of Papua New Guinea; Cultural Studies Division of the National Research Institute; and the Curriculum Development Unit in the Department of Education.

It is worth noting that this option has been already been successfully pursued by OTML in the past, for modest outlay (e.g. Swadling 1983). A cooperative effort in Enga worth comparing with the needs of North Fly is that of Kyakas, Wiessner and Ipu (1992). I note OTML's high-profile sponsorship of sport and do not detract from this. However, I do draw attention to the contrast between the allocation of resources to sport, dance teams, and air travel to cultural events — all part of contemporary Papua New Guinea — and more substantial cultural undertakings. Ideally, a better balance between cultural events 'for consumption' and those with value 'for posterity' could be maintained.

Some of this material might be incorporated into reading and writing materials and exercises. Given recent education policy changes aimed at placing teachers in their own language areas, and particularly given the influence of the Catholic Church in education in Western Province, this project might best be carried out through the aegis of the school system. Other projects might focus on traditional knowledge of the environment, e.g. names for plant and tree species, or traditional technology. Another focus for cultural preservation might be to develop a small museum or cultural centre in Kiunga.

Employment Issues

Most modern mining operations, once construction of infrastructure is complete, provide very few jobs for unskilled and semi-skilled labourers. Even with this caveat, the number of Yonggom employees of the mine is rather low. Figures provided by OTML's Manager for Business and Community Relations in 1989 (Marty Bos, letter dated 18 January 1990) indicate that only ten persons were employed directly by OTML from thirteen of the Yonggom villages in the

census districts under study. More recent data provided by OTML (King 1993) suggests that this number has increased to thirty-seven.²⁴

The Yonggom claim that OTML has preferentially hired Star Mountains and Telefomin District workers over people from the area to the south, despite the fact that they are also officially regarded as 'preferred area' people.²⁵ Whether this perception of bias is valid or not, continued vigilance is needed to ensure that there is equity in hiring workers. Jackson's recent monograph has reopened the subject (1993:75-96), but with the specific aim of testing the predictions of the original impact report (Jackson et al. 1980). A point in question is the inexact recording of the village of origin of OTML employees; Jackson found that forty-three employees listed as of 'Ningerum' origin were from West Awin villages (1979:95). Experience at other projects — e.g. Kutubu (Burton 1993d:3) and Porgera (Banks 1993:34) — shows this imprecision to be unexceptional, but it makes the task of proving fairness (and social monitoring) unnecessarily difficult. In any case, given that more than a decade has passed since the mine began construction, it would be timely to undertake a review of the current state of employment.

In the case of the Ok Tedi mine, most of the subsidiary operations that provide services to the mine are independently owned and run. In other words, OTML is indirectly responsible for a great many more jobs than analysis of its employment records reveals. To meet future needs, greater economic development in the present study area is required. This requires a new development plan; in this context, Kiunga District employment patterns and business successes should be re-examined.

Market Issues

In a brief survey of Kiunga market (Table 5), I found people from over forty settlements selling a broad variety of products. The majority were selling garden produce, which ranged from traditional greens and bananas to introduced vegetables and fruits. Others sold tree crops, bush fruits, sago and smoked meat. No fish were on sale when I visited the market. Craft products were being sold by refugees.

Awin sellers outnumbered Yonggom sellers five to one. The Awin have better access to the market from neighbourhoods in Kiunga, from settlements built along the Kiunga-Tabubil highway, and from several villages located upriver from Kiunga along the Fly River. Presumably, later in the day, the balance might have been somewhat different, as people would have had an opportunity to arrive from more distant villages. But, based on information from

²⁴ See Burton (1993b) for further analysis of employment figures.

²⁵ The Kiunga District of Western Province and Telefomin District of West Sepik Province, designated as having preference over other parts of Papua New Guinea for recruitment purposes. After the original mining agreements were signed, Kiunga was subdivided into the Kiunga and Tabubil Districts

people living in the villages, the lack of Yonggom participation in the market is due in part to the difficulty in obtaining affordable transportation, and in part due to the lack of any surplus food to sell. Only one Ningerum seller was at the market.

Table 5: Products in Kiunga market on 27 July 1992.

Category	Variety	No. on sale
Greens		4
Bananas	one ripe: six cooking	7
Root Crops	sweet potatoes, taro tru, taro kongkong, yam	4
Vegetables	cucumber, pumpkin, beans, Ch. cabbage, sugar cane	5
Fruits	papaya, pineapple, lemon, soursop	4
Nuts	coconut, okari, peanut	3
Bush fruits		3
Sago		1
Smoked meat	pig	1
Fried dough		1
Other bush produce	stinging nettles, string, feathers	3
Finished products	string bag, sago strainer, paintings	3
Total		39

I was told that, in the past, more Yonggom participated in the market, selling fish and other riverine produce. However, as one resident of Kiunga put it, 'We're not sure whether it is safe to eat fish from the river'. Thus, buyers are suspicious of fish from mine-impacted areas. Given the greater cash return from fish than from garden produce, it is not so easy for people from distant areas to participate in the market; they cannot afford to pay their transportation costs from vegetables alone. In addition, for many of the communities along the Ok Tedi, there is little or no surplus available for sale at the market.

As the population in Kiunga continues to grow, it is reasonable to expect that the market will expand to meet the needs of the local population. The region would benefit from the participation of additional villages in the market; suggestions along these lines are made on a case-by-case basis in the sections above. It is hoped that alternative sources of income will be developed in order to offset the loss of sales of riverine produce.

Table 6: Origins of 48 sellers in Kiunga market on 27 July 1992.*Sellers from Awin settlements*

Place	Settlement Type	Number
Haewenai Corner	Corner	3
Tmoknai Corner	Corner	2
Seven Corner (Kiunga)	Corner	2
Rumginae	Highway	1
Ki	Highway	1
Seven Corner (road)	Highway	2
Yomnae	Highway	2
Grimgas	?Bush	2
Drimdemasuk	Fly River	1
Drimgas	Fly River	5
Tipensomnae	Fly River	1
Drimgas	Fly River	5
Gre	?	3
Somoikwankia	Bush	2
Rubber Corner	Corner	1
Kusure	Fly River	1
Sub-total		34

Sellers from Yonggom Settlements

Place	Settlement Type	Number
Alice Corner	Corner	3
Last Corner	Corner	1
Atkamba	River	1
Michael Corner	Corner	1
Sub-total		6

Other Sellers

Place	Settlement Type	Number
Ningerum Corner (Kiunga)	Corner	1
Iowara Resettlement Centre	Refugee Camp	2
Niogamban Border Camp	Refugee Camp	2
Kiunga vocational school	Urban	1
Woman from the Highlands	Urban	1
Michael Corner	Corner	1
Sub-total		8

Ok Tedi-Fly River Development Trust

The projects implemented by the Trust have been well-received. When travelling through the area, the impact of the Trust projects is readily apparent. The water tanks, community halls, shower blocks, aid-posts and other facilities have contributed to the overall well-being of the villages.

Nonetheless, the villagers have many unanswered questions regarding the organisation of the Trust, including the source of the funds, whether or not the company considers this to be 'compensation' for its ecological impact, and how decisions are made regarding the distribution of projects and village development funds.

Another concern is the issue of maintenance of the Trust projects. While I was informed that this year's (1993) Trust patrol will begin to carry out routine maintenance tasks, an annual inspection may not be sufficient. When things break or problems arise, there should be a way for villagers to contact Trust officers. For example, in Dome village, the water tank beside the aid post has become contaminated with thousands of small worms, and the floor of the tank may need to be re-sealed, a task the villagers cannot carry out themselves.

Villagers also expressed their concern about the haste with which some of the projects seem to have been planned and carried out. For example, many of the water tanks lack proper drainage, such as a concrete catch-basin and a pipe to divert spillage. Discharge from the tanks is currently eroding the foundation of a number of tanks constructed on hillsides. A related criticism is that the projects were not necessarily built to last for a long time. For example, the shower blocks have raised wooden floors, which would seem to be far less durable than concrete. A number of people questioned the value of projects with limited lifespans.

Indeed, the very notion of the Trust was questioned by some, who likened it to a public relations campaign. 'Too much noise, too much publicity,' said one person. Another complained that there was no maintenance and no follow-up; the projects amounted to 'brainwashing' rather than real compensation. Another person pointed out that before the mine began operations, they could swim in the Ok Tedi and the water in it was drinkable. The Trust has given them drinking water and showers, but this hardly means that they are better off now than before the mine began production.

The first two years of the Trust were focused on infrastructure, which raises some interesting questions. There does not seem to be a positive correlation between the level or standard of facilities — for either health care or for rural education — and the quality of the services delivered or the level of community participation. For example, Dome village has a permanent school building and houses for teachers, yet student absenteeism (and indeed, drop-out rates prior to the completion of sixth grade) are high. In contrast, Komokpin has neither the facilities nor the problems with student attendance. Furthermore, parents at Komokpin are actively involved in the school programme, while parents at

Dome are reluctant to participate in volunteer work. In another example, Komokpin has both a new aid post and a new house for the resident health care worker, but at the time of my visit, the health care worker had been absent from the village for a month, and no-one knew if or when he was scheduled to return.

Cash Payments: Village Development Fund

OTML conducts its own censuses of the villages included in the programme, including the number of people, the number of houses, and the number of families in each village (see King 1993). A crucial issue in the eligibility for receiving VDF payments is residence in the village, picked up during the census enumerations.

Let me give an example. A head count at a given moment in time is likely to produce a different figure than the response to the question of 'who lives in the house?' There are people who have spent the majority of their adulthood in Kiunga, yet are still considered to 'live' in a particular house. Some people maintain their village houses even though they live in town. Is someone who is away for a week in Kiunga during the census patrol to be included in the census? How about someone who was visiting family in the village? Someone who spends several months a year in town? A man whose wife and children live in the village while he works and lives elsewhere? Someone not present during the census patrol, but on a retreat to his land in the rainforest, rather than in town?

In the first two distributions, some of the people listed on the census lists actually live in Kiunga. This led villagers to conclude that it was 'company policy' to distribute money to some, but not all, of the people living in town. Townspeople who did not receive a share of the VDF became angry because they felt unjustly excluded.

Each village was free to divide the money it received in any way it chose. The Yonggom divide the VDF monies in terms of one share for each name on the census list. Because of this, Pastor Kirine Yuandit told me that the method of payment 'imposes Western, individualist ways of treating people' on the Yonggom. Furthermore, because the company excludes most of the townspeople from payment, Yuandit says that it damages the exchange relationship between townspeople and villagers; the former have helped the latter for years and expect reciprocation which is not forthcoming.

Another question concerns land ownership. Among the Yonggom, land is individually owned (Schoorl 1970). The question arises: should VDF funds be paid to absentee landowners for damage to their property? It might be possible to consider two types of impact that the mine has on people downstream. The first has to do with property rights (landowners are known as *ambip kin yariman*). A landowner has rights to land and resources whether or not he or she lives in the neighbouring village. The second type of impact has to do with livelihood (known as *animan od*, or 'food and money'). These people should be compensated for the infringement upon their ability to make a living and feed

themselves. The Yonggom consider it unfair that only one class of people affected by the mine is receiving reparations, and that some landowners receive no recompense for damage to their property and resources. It is possible that continued distribution of VDF in this manner may lead to conflict between the two groups of people.

The VDF payments made in 1990 are shown in Table 7, and are taken from Trust records made available to David King. The payments should be consistent with the number of people in each village, though possibly the amount allocated per head is different in different parts of Western Province. In the present case, while Zone 4 people received K40 per person as against K20-K23 in the other zones, the amounts appear to vary markedly between villages. It may be that incorrect figures were provided to King, or that they mask several kinds of payments made under the guise of the VDF; more information is needed on this. At present all that can be seen is the approximate size of payments.

As the table shows, VDF outlays do not add up to very much per person. Sums of K30-K40 are large enough to cause a small increase in trade store receipts — if, indeed, the money is spent in the village — but little else. In fact, the distribution of money in this manner encourages immediate consumption. Even a family's income of K150-K200 will only meet meagre household needs, such as school fees, clothes, food, small debts, a saucepan, etc.

At Dome village, where people each received K56 in 1990, about K4000 of the most recent payment went to people living in Kiunga. The trade stores were stocked shortly after the money was distributed, and most of the villagers will spend their share buying rice, tinned fish, clothes and other incidentals. The money will not last long, they told me; perhaps a month. They were pleased to get the money, but it will not have a real impact on their quality of life.

Finally, in many villages I was asked questions about the operation of the VDF. In particular, people wanted to know why some villages received more than others, and how these figures were established. They wanted to know how the village lists were drawn up. They also asked whether the funds were intended as 'compensation' or some other sort of payment. The disparities in eligibility and amount received have apparently resulted in conflicts and other social problems.

Table 7: VDF payments to villages in the study area, 1990.

	Population	VDF payments	Payments per head
<i>Zone 1</i>			
Kawok	113	K2,160	K19
Moian	408	K9,400	K23
Ulawas	293	K4,920	K17
Total (mean)	814	K16,480	K20
<i>Zone 2</i>			
Erekta	281	K5,840	K21
Karengu	586	K5,120	K9
Membok	401	K16,040	K40
Kukujaba	172	K6,000	K35
Total (mean)	1440	K33,000	K23
<i>Zone 3</i>			
Birimkamba	205	K2,280	K11
Ambaga	318	K11,640	K37
Kungembit	150	K1,710	K11
Total (mean)	673	K15,630	K23
<i>Zone 4</i>			
Komokpin	324	K11,220	K35
Yogi	216	K15,180	K70
Dome	411	K23,220	K56
Yeran	105	K3,780	K36
Bongabun	53	K3,180	K60
Atkamba	495	K17,100	K35
Konkonda	359	K12,180	K34
Bige	66	K3,780	K57
Total (mean)	2029	K89,640	K44

Source: King 1993, Table C.

I realise that the VDF programme is currently under review. One option for the future is to use the funds to invest in local companies, giving villagers shares of stock. Similar policies have been very effective in the case of start-up companies in the mountains. Before any investment is made, however, I strongly recommend that an independent assessment of the value and the long-term viability of the investment be carried out.

Other Social Problems Associated with the Village Development Fund

I was in one village when VDF monies were distributed, and witnessed a number of recipients engaged in an all-night gambling session. This is one result of the sudden infusion of cash into the village. Although Zimmer (1986) argued that gambling among the Gende of Madang Province reinforces traditional exchange

practices, reduces income disparities, and provides wage-labourers with stability by enabling them to renew their rights to land and resources, in the Yonggom case, gambling appears to have the opposite effect. The Gende begin with disparity and gambling has a leveling effect, while the Yonggom start with equal shares that end up being unequally redistributed.

Those present at the gambling session ranged from unmarried men in their twenties to senior men, including the village councillor and committee members. In addition to unequal redistribution of the monies, the evening resulted in conflict over allegations of cheating and stealing.

I should point out that the Yonggom are familiar with card-playing and gambling from these activities in town. My concern here is with the extension of these activities to the village, something that I had not witnessed before. Another potentially worrisome trend involves the use of VDF money to purchase beer for consumption in the villages. When beer is consumed in town, there is little net impact on the village apart from the loss of resources. In contrast, when beer is brought back to the villages, its consumption results in numerous disturbances and fights. I expect the trend to increase and worsen as transportation improves.

The Problem of 'Villages' in the North Fly

As VDF — and all Trust activities — are structured around the concept of the 'village', it should be noted with caution that the 'village' is really an artificial social unit in the study area. There is no word for 'village' in the Yonggom language, hence loan words like *kampong* in Malay, *hanua* in Motu, *ples* in Pidgin, or the English 'village' are used to refer to local settlements.

Until the 1940s, the Yonggom lived in small hamlets composed of two or three houses each. Some of these settlements were located on or near current village sites along the Ok Tedi; most, however, were located in the rainforest interior between the river and the border. Both the size and the location of these hamlets were partially a response to the predatory head-hunting expeditions of the Middle Fly people, especially the Boazi. Low population density was also efficient for gardening, sago production, and hunting.

In the 1940s, Australian patrol officers encouraged the Yonggom to establish nucleated clan settlements, including Dimin, Kueman, and Woran. These settlements had populations of between fifty and one hundred people, and were located on or near old hamlet sites, usually away from the river. In the early 1960s, the Yonggom moved once again, this time to their current villages, many of which are on or near the Ok Tedi. These villages were even larger.

As a result of these historical developments, current villages in the North Fly do not represent enduring entities, but recent and fragile groups. They do not have the corporate solidarity or the level of cooperation that we might expect from an established village. Instead, they possess much the same individualistic orientation that we associate with life in towns and cities.

Several important consequences follow from this fact. First, it cannot be reasonably assumed that villagers can reach agreement to work on a development project together. Furthermore, it would be unreasonable to hold the Yonggom accountable for this inability to organise themselves at the village level, any more than it would be to blame a neighbourhood in Sydney or Melbourne for not acting in concert.²⁶

A more appropriate strategy for establishing development projects is to focus on existing kin groups within the village. J.W. Schoorl (1970), a Dutch government anthropologist who worked among the Yonggom (or Muyu) in then Netherlands New Guinea during the 1950s, referred to primary Yonggom kin groups as 'lineages'. Today the operative kin group seems to be the clan, which is typically composed of a number of lineages, which may own land scattered over a wide area. Examples of Yonggom clans are Meremko, Woran, Kueman, Dimin, Wambiran, Yetini, and Miripki. Clans are divisible into lineages: Meremko clan, for example, includes the lineage Ogan-Meremko, which owns land at the junction of Wuk creek and the Ok Tedi (south of Dome village), Meremko-Kakburan, which owned land beside the old village of Kawangabun, close to the border, and several additional lineages.

Complicating the system is the fact that clan names used for villages established in the 1940s and 1950s have been redefined in terms of residence, so that they may include members of these settlements, regardless of prior kinship affiliation. In any Yonggom village today, one may find members of approximately five to ten different clans divided up into perhaps as many as twenty lineages in total.

People from different clans frequently do not trust each other. There is no reliable political structure or authority above the level of the clan. There are no local 'big men'. Even though there are village councillors and committee members, they are generally regarded as representing their own interests or those of their clan, rather than acting on behalf of the community at large. It is difficult to reach decisions that are widely accepted within the village, and virtually impossible for a leader to impose his will on the community. Hence any project organised at the village level is likely to have limited chances of success.

Ideally, VDF money should be paid out and projects organised at the level of the clan or lineage, and not the village. More detailed social mapping of villages would reveal the main lines of organisation, a task which is beyond the scope of the present project.

²⁶ Recent marriage statistics (see Table 2) indicate high rates of village endogamy, which will presumably contribute to village solidarity.

Refugee Issues

In 1984, more than 10,000 refugees from Irian Jaya crossed into Papua New Guinea on foot. Their motivation was largely political; they were protesting against the Indonesian military government that controls Irian Jaya. Many of the refugees naively hoped that their actions would lead to political change within Irian Jaya within a short period of time. Given that this was not to be, however, their commitment to the same ideal, regardless of how long it will take, is nonetheless remarkably undiminished. In the nearly nine years since their arrival in Papua New Guinea, fewer than one third of the refugees have returned home despite promises of safe repatriation. Throughout their stay in Papua New Guinea, the refugees have endured many hardships, including periods of hunger and even starvation, separation from family members who remained behind, limited access to land and other resources necessary for subsistence, limited participation in the cash economy, and some restrictions on access to medical care and education for their children. Despite these very real difficulties, the refugees have remained willing to continue their sacrifices in the hope of bringing about political change in Irian Jaya.

Several thousand refugees, most of whom crossed the border into West Sepik Province, have taken up more permanent residence in the resettlement centre in Iowara (East Awin Census Division), where conditions are steadily improving. The majority of these people were moved to Iowara after the border camps in which they originally settled were closed.

Roughly 4000 refugees, however, have resisted attempts to transfer them to the resettlement centre at Iowara. They have remained in six camps, all located within a day's walk from the border. According to figures provided by Bishop Deschamps of the Montfort Catholic Church, which provides aid and social services to the Catholic refugees, more than 800 people live at the Timkwi camp. Roughly 60 to 100 people live at Kungim, adjacent to the Yonggom village of the same name, and several hundred more refugees claim official residence there. At Yogi village, the camp houses approximately 400 refugees. At Dome there are another 750 persons, which brings the total population of the area between Dome and Yogi to approximately 1500 people. At Kuyu, where there was no pre-existing Papua New Guinea village, there are more than 800 people, and at Niogamban, another 400 people. Despite basic aid provided by the Catholic mission, the conditions under which these people live are difficult. In particular, the refugees who live close to Papua New Guinea villagers often compete with them for access to limited natural resources.

It has become somewhat fashionable for expatriate observers to claim that the refugees were motivated to come to Papua New Guinea because of economic opportunity. Such assertions reveal ignorance of the conditions in which the refugees live, particularly those who have stayed in the border camps. While the Ok Tedi mine has transformed the economy of Western Province, very little of its benefits accrue to the refugees. They have far fewer economic opportunities than their neighbours in nearby villages. They live under much more difficult

conditions in Papua New Guinea than they did in Irian Jaya, where they had wide-ranging access to resources, including hunting and garden land, sago stands, and some opportunities for employment. The camps are greatly overcrowded, and interpersonal relationships are often strained. Inadequate waste disposal results in contaminated water supplies and greater vulnerability to illness. Available hunting land and sago stands are often at great distances from the camps. Basic tools (e.g. steel axes and shovels), kitchen supplies (e.g. cooking pots, dishes), and even clothing are in short supply, and few refugees have access to funds with which to purchase these goods. While this situation is gradually improving through the assistance of the Montfort Catholic Mission, the refugees are among the most disadvantaged people in Papua New Guinea.

Two major issues with regard to the refugees are relevant to this report. First, the refugees live in camps along the Ok Tedi and the Fly River below its junction with the Ok Tedi. This is also the area of OTML's greatest environmental impact. Given that the population of the camps far outstrips the population of nearby villages, the presence of the refugees has greatly increased pressure on available resources, particularly given traditional subsistence techniques (Kirsch 1989). Even in the case of border camps that were abandoned after several years of occupancy, the impact of the refugees continues to be felt, both in terms of the extensive areas of forest land that were cleared for gardens and must subsequently lay fallow for 10-12 years, and in terms of the widespread plundering of game. Refugee consumption of resources and the environmental impact of the mine combine in a destructive synergy that impacts severely on the natural environment. Some of the problems attributed to the direct impact of the mine may be more accurately considered to result from the interaction of the two forces. In other cases, population pressure may have a greater impact on the natural environment than the mine. The second issue, discussed in the next section, is the extent to which the refugees might pose a threat to the mine itself.

SUMMARY AND CONCLUSIONS

Main Issues

I identify the following as key issues:

- environmental damage along the Ok Tedi;
- mistrust of OTML in all villages in the study area;
- the potential for civil disorder;
- compensation and social development.

Environmental Damage

While one group ostensibly has little to worry about — those on the arm of the Fly between Kiunga wharf and the Ok Tedi junction — they still have exaggerated fears of the possible impact of wharf operations. Equally, in the villages to the northwest of the junction of the Ok Tedi and Ok Birim rivers, the depletion of local resources by large numbers of refugees may lie behind perceptions of environmental degradation, which local residents attribute to the ‘copper *marasin*’ or ‘poison’ that has travelled considerable distances from the mine site. But for the remaining villages, environmental damage is real enough.

The resources affected are the river itself, fish and other aquatic life, forested areas along the river, gardens and hunting resources, and sago stands. I have discussed these environmental impacts at length in previous sections, but I wish to briefly address the purpose of environmental monitoring. Properly conceived, monitoring must involve feedback, so that when a problem is discovered, a strategy of mitigation can be devised. In the present case, the feedback loop, which has been devised in terms of company-governments linkages, is faulty, involves too long a delay, or is not proven to exist. Specifically, severe environmental damage dates back more than five years along the Ok Tedi River, but measures to mitigate this have not been taken in response. What purpose does monitoring serve when there is no effective response?

Mistrust of OTML at Village Level

There is a high level of mistrust of OTML in all villages in the study area. Nothing I discovered in interviews leads me to think that the confidence of the rural people will be easily regained. A key issue is the public acknowledgment by OTML of the impact that its mining operations have had on the Ok Tedi and Fly rivers. The next two decades of continuing production are dependent upon OTML’s ability to secure the trust of the people of Western Province. The necessary first step in this process is to improve communication between the company and the people.

For a high school teacher in Kiunga from Atkamba village, the main issues were communication and trust. He told me that the people do not understand why one report says one thing and another report says something different. They find it disturbing that reports and plans are held in confidence and kept secret, rather than being circulated and explained. I may add that rumours circulate anyway, and in the absence of reliable information there is no way to stop the spreading of flawed or inflammatory claims about the effects of the mine on the environment.

A case in point is the number of times villagers told me that a ‘scientist’, a ‘German scientist’, ‘the company’, or a ‘government officer’ had visited and told them not to make gardens along the river, use the river itself, make sago anywhere near it, or catch and sell fish.

In order to overcome the mistrust that I found had built up in the villages, positive steps are needed to facilitate interaction with willing politicians, political action groups, environmental organisations and other inquiring parties. Here I may mention that the largest effort is not required at company headquarters, but in the community at large.

The Public Need for Information: A Call for Ecological 'Glasnost'

I regard the public's need for more information regarding the environmental impact of the mine as a key finding of my research. This is not so much a question of releasing 'data' — which mean nothing out of context — as of making understandable information much more accessible.

The public's lack of confidence in OTML is partially the result of the inaccessibility of basic information regarding the mine's environmental impact. Whereas OTML may have satisfied its legal obligations to the national government of Papua New Guinea with regard to the presentation of environmental data, it is a matter of self-interest to communicate much better than at present with the people living in the environmental impact zone (see Hance, Chess and Sandman 1990).

A first step is to make the results of various studies and reports produced by OTML's Environment Department and the work of outside consultants much more accessible to the public: I call this 'ecological glasnost'.

This might be accomplished in part by establishing a small library and reading room in Kiunga. There are many groups of people that would like access to this material, including school teachers, provincial government officials, extension workers, environmental activists and mission workers. At a higher level, documents relating to all aspects of the mine are in principle held at the Department of Mining and Petroleum library at Konedobu, but experience shows that the holdings are incomplete. To cover all bases, it is well worthwhile making sure that research and archival material reaches the Michael Somare and Matheson libraries at the University of Papua New Guinea and the University of Technology. This would give faculty and students, as well as journalists, politicians and visiting scholars, access to accurate, rather than speculative, information regarding the mine and its impact.

It may be difficult for those close to the project to grasp the need for open access to information; but, given the high national importance of the Ok Tedi mine in Papua New Guinea's post-independence history, the interested, but not necessarily technically minded, reader finds that many issues cloud 'the Ok Tedi question', while clear answers to basic questions are hard to find.

Limiting access to information concerning the environmental impact of the mine undermines OTML's relationship with the people of Western Province. One way to reverse this trend would be to produce, and make readily available, a comprehensive report and analysis of the mine's social and environmental

impact, as well as predictions for the future.²⁷ The presence of such a document as a matter of public record would lead to more informed debate on the mine, and help to clarify numerous popular misconceptions about its impact. It would be useful if more emphasis was placed, in future OTML Environment Department reports, on summarising the findings in non-technical language suitable for lay readers.

Suggestions for Improved Communication between OTML and Local People

Beyond the accessibility of information is the evident weakness in formal lines of communication between OTML and the people in the impact zone. The use of the provincial government as a go-between has not proven effective. This is reinforced by the fact that the provincial government's own formal links with villagers, the council system, has been brought to a standstill through inefficiencies or incompetencies within the bureaucracy (see Burton 1993b). The end result is that villagers have no established way of sitting down to talk with the company, nor the company an established way of delivering its ideas to the villagers. Naturally, Community Relations field officers make visits to villages in the Trust, but I found that villagers were never really clear whom they had met — with the exception of the senior staff members — nor could they recall the date or purpose of the most recent contact.

One way to redress this problem would be to train people from each language area in the impact zone to work as company liaison officers. Their training should emphasise both basic science and information concerning the environmental impact of the mine.²⁸ Over time, this programme could improve communication between people living in the impact zone and OTML. Their jobs should involve the communication of information in both directions.

OTML may also wish to consider filming short video responses to pressing questions faced by people in the impact zone. These videos may be dubbed into the local language before being shown. Video presentations, coupled with follow-up discussion led by local liaison officers, might be the best way for OTML to disseminate information to the villagers.

OTML should also work to educate its other employees about the mine's environmental impact. These workers often tell other people in town and in the villages about mine operations; it is imperative that they have access to accurate information. Let me present an example. A man who works on the wharf at Kiunga told me that water from the copper slurry pipeline is released directly into the Fly River. He said that 'chemicals' and 'black waste' (possibly referring to town sewage) were going into the creeks that surround Kiunga,

²⁷ Ironically, I have found the most comprehensive document produced about the mine in the last ten years to be the in-house rebuttal of the critical Starnberg report (BIIP Minerals 1991).

²⁸ The implicit model I am following is that used to train health care workers in Papua New Guinea.

affecting local flora and fauna. As an 'eyewitness' to wharf operations, it is imperative that he have an understanding of the steps that the company is taking to limit, recycle and treat potential contaminants from the wharf operation prior to their release into the river.

OTML might also consider whether it wishes to support the development of local science education. Given that the level of education in Western Province is the lowest in Papua New Guinea (Gibson and Weeks 1990), one possibility is to contribute as a sponsor to in-service courses for provincial science teachers, in conjunction with the development of appropriate curriculum materials.²⁹

Finally, education, like communication, should be a two-way street. It should be recognised that the local people know much about their own environment that Western scientists have not yet begun to study. Tropical rainforests are complex and easily disturbed ecosystems. As I have mentioned, villagers in the study area are acute observers of nature and, although they may present this information in ways that reflect cultural differences, they may see troubling signs well ahead of scientific confirmation.

The Potential for Civil Disorder

As I have indicated at various points, the people generally support the mine in principle, but the degree of animosity caused by its environmental impacts is high. Sustained anger and frustration over a long period of time could eventually lead to violent action directed against the mine. Without some change in the company's current environmental practices, the mine's impact on the river system and the adjacent flood plain will remain problematic and, as the overall 'quality of life' in the villages continues to decline, the potential for a violent response against the mine will increase.

The Potential for Violence in the North Fly

Given the violence and continuing problems at the now-closed Panguna copper mine in Bougainville, it is reasonable to consider the potential for violence in the North Fly. At the time of this research, despite the fact that people are very critical of OTML's environmental policies, the general consensus of the people in the North Fly towards the mine is favourable. If their concerns regarding the impact of the mine on their environment are not addressed in the near future, however, this opinion could change.

The people of the North Fly are largely in favour of development, but not at any cost. As John Beyang, an Awin man employed at the mine site in the past, told me:

²⁹ When I spoke with Western Province teachers about the possibility of conducting similar programs in their own time, they rejected the proposal, pointing out that they were already over-worked and under-paid. It seems reasonable to compensate them in some manner for extra duties.

The people are not unhappy with the mine. We do not want it to close. We just want them to build a tailings dam. Every other developing country that has a mining industry forces their mines to build tailings dams to protect the environment.

To John Beyang and many others, the mine's impact on the river system and the benefits that the people receive from the mine in the form of Trust projects and VDF monies, are separate issues. While the 'Trust projects are okay,' John told me, 'we still want them to build a tailings dam'. According to this point of view, OTML needs to solve the problem of tailings disposal in order to keep the support of local populations.

Many people argued that it would not be in the best interests of the people of the North Fly if the mine were to close. To paraphrase a schoolteacher in Kiunga:

Why shut the mine down when that would keep them from paying compensation for damages they have already caused?

Furthermore, with the mine open, there is 'more money around and more work available'. Two representatives from the Ok Tedi Landowners Association echoed this point of view. They said that they had two major demands, and that all other concerns were minor in comparison. First, they wanted long-term compensation backdated to the start of production at the mine in 1984. Second, they wanted OTML to build a tailings dam. 'If they cannot meet these demands,' I was told, 'then they have to pack up and go.'

This is a very different starting point than the situation in Bougainville, in which mining was opposed from the beginning. Western Province has a history of underdevelopment compared to other provinces, and the desire for development, for increased opportunity and for more choices, has been consistently strong. Even Isadore Kaseng, Premier of Western Province and an outspoken critic of the mine, confirmed that the people of the province do not want the mine to close, but that they do insist that its tailings be contained, and that appropriate compensation for damages to the environment be paid to the people who have been adversely affected.

From the vantage point of the North Fly, there are two potential scenarios for violence. The first involves the formation of an alliance between the refugees, the OPM (*Organisasi Papua Merdeka*, or Free Papua Movement) and villagers opposed to the mine. While this remains an unlikely possibility, one lesson from Bougainville is to give such threats serious consideration. Several factors contribute to the possibility that these three groups might decide to act in concert. The most important reason, generally overlooked in other analyses, is that the majority of the refugees living in the border camps speak the same language and share the same customs as the people living in the nearby villages. These villages, located on the Ok Tedi and Fly rivers, have suffered great environmental disruption caused by the mine. The villagers are frustrated by their inability to communicate with the mining company and voice their concerns about the mine's impact on their environment. The refugees are

similarly frustrated at their lack of impact on affairs in Irian Jaya, and the OPM may wish to draw additional international attention to its efforts.

Although the OPM has had limited military success in the border region, its organisational capabilities should be judged by its successful efforts in spearheading the mass exodus from Irian Jaya in 1984. Thus far, the political interests of the refugees and villagers have not been linked, and at present there is little consciousness of the possibility that the Yonggom might act as a corporate group of roughly 15,000 people in order to bring benefit to both local landowners and the refugees. This could change. I do not know, for example, whether developments in Irian Jaya, such as the recent discovery of oil reserves in the nearby Waropko Sub-District, could serve as a catalyst for such conceptions.

The second possibility for violence is that local people would join up with striking or protesting mine workers. Relations between these two groups generally have been somewhat antagonistic, in part due to low rates of employment of Yonggom men at the mine. During previous worker actions against OTML, however, sentiments of solidarity with the workers were expressed in the villages. There were even brief discussions about joining the actions by closing down the Kiunga-Tabubil highway and the Kiunga airstrip.

This discussion is limited because I am unable to evaluate the likelihood that the people of the North Fly will resort to violent action against OTML if their demands for environmental protection and compensation are not met. I can say with confidence, however, that such action is generally considered to be a matter of last resort.

Formal Compensation Measures

While it is OTML's policy to compensate for garden and forest losses, as of the date of this study, there have not been any such payments in the Yonggom area. Burton (1993a:9) has described the shortcomings in the procedure for registering compensation claims, noting that the key problem is the delay between the first notification of complaints at district level, the official investigation by the Port Moresby-based Mining Warden, and the final distribution of payments to villagers by OTML and district staff. In the only cases to have yet reached the stage of payment (mostly between Km 90 and Km 104 along the Kiunga-Tabubil highway, and at Migalsimbip), the time elapsed was twenty-three months from the date of the first known documents which mention the complaints.

With regard to the Yonggom area, field investigations have included inspection tours, but not Mining Warden's investigations. For example, after a written complaint from Dome village in September 1991, provincial government officials visited the area between Ningerum and the D'Albertis Junction in a helicopter provided by OTML on 29 October 1991. Their situation report recommends cooperation between OTML and provincial government divisions to assist the affected villages, and adds that food could be supplied to badly

affected villages when gardens are destroyed. This is not the same as a field survey for compensation assessment, in which destroyed gardens must be measured and losses properly tabulated; a survey of this kind has yet to be done.

Taking a date of mid-1988 for the start of major damage, as I have reasoned above, it is safe to say that the delay in processing Yonggom compensation claims has now stretched to five years.

It is government procedure to work out compensation for losses by tallying the individual plants and trees that have been destroyed. In the lower Ok Tedi, this method will not be possible to apply because the destruction in question has long since removed any evidence of damage to individual plants; complete gardens have even been removed. Burton (1993b) also argues that, however the value of a particular economically useful crop is calculated, the result is never likely to be satisfactory except when damage is very localised and can easily be repaired. An alternative strategy would be for OTML to extend its mining lease to cover that region. Another alternative, proposed by Rex Dagi of ENECO, an indigenous environmental group, is that landowners be compensated with partial ownership of the mine, i.e. with equity.

In any case, a concerted effort must be made to speed up assessments of damages and to fast-track the claims through the Mining Warden's office.

Development and the Trust

Where should OTML and the Development Trust go from here? My answers, which should be evident from the discussions above, is that *in its present form* the Trust has a rather ambiguous position. It is neither a substitute for compensation nor a proper vehicle for development. With regard to pure compensation matters, the scale of the Trust's operations are too small to be seen as a restitution for losses in the present study area.³⁰ I will note, however, that when compensation does come, its unassisted distribution in cash will predictably not help the villagers, because of their limited capacity to make productive investments. An example of what I mean by this is that investment in commercial agriculture, an obvious choice, is likely to disappoint while prices, transport infrastructure, and extension services are so weak.

On the other side of the coin, current Trust activities are spread so thinly that, with a few exceptions, it is unable to bring development at a reasonable and sustained rate to the villages I have visited. Naturally, things may be different when the network of roads that the Trust has plans to build is completed. However, this is some time off, and the people I visited have very obvious short-term needs that a proper plan for development should address. Among the things I have mentioned in this report, I have no hesitation in singling out health, nutrition, and subsistence crop extension services as the areas which call out for

³⁰ This may not be true in less impacted areas of the river system.

more attention. I hope that these issues can be addressed in conjunction with provincial and church authorities as a matter of urgency — it will save lives.

In the long term, the activities of the Trust in the study area would be placed on a much more satisfactory footing if a proper development plan were in place for the North Fly. Technically, the provincial government's existing five year plan for the area (Department of Western Province 1988) was about to expire at the time of my fieldwork; in practice, it had been abandoned at birth.³¹ With no plan, I and the other members of the social monitoring team have no benchmarks against which to measure progress. Hopefully, this situation will not last indefinitely.

Summary and Conclusions

I have focused on three major issues regarding the social impact of the Ok Tedi mine:

- the effect of the mine on the environment, *as experienced and interpreted locally*;
- suggestions for improving communication between OTML and the impact area people; and
- prospects for long-term relations between the two parties.

Environment

In my view, the company must pay greater attention to the following environmental problems in the study area: river bank overflow, deforestation, damage to sago stands, and siltation of secondary waterways and swamps.

In Zone 1, along the Fly River between Kiunga and the Ok Tedi, concern about the impact of wharf operations on the Fly River has led villagers to abandon use of riverine resources, even though evidence from the OTML Environment Department indicates that this response is probably exaggerated.

In Zone 2, along the Fly River from the Ok Tedi to the Binge, sedimentation has had some impact on local resources and their use. Environmental monitoring needs to be extended here, especially to the Binge River villages, and efforts should be made to safeguard their resources from further impact.

In Zone 3, the villages west of the Ok Birim junction, villagers make claims of widespread ecological degradation, which they attribute to the 'copper *marasin*' or 'poison' from the mine. The environmental impact of large refugee populations is great here, and programmes should be instituted to increase local subsistence productivity.

³¹ Information supplied to John Burton by Martin Paining.

Finally, in Zone 4, in the Ok Tedi River villages, the impact of the mine is the greatest. The combination of deforestation, decline in riverine resources, and loss of garden and hunting land, plus the impact of the refugees, poses serious challenges to food production along the lower Ok Tedi. In addition to nutritional assessment studies and development plans, OTML must expedite compensation payments to landowners and residents.

Communication

Proper attention to the feedback relationship between environmental monitoring efforts and policies regarding production is imperative. I have also suggested that OMTL formulate new policies with regard to information about the mine's environmental impact. There is a great need to improve communication between the company and the people in the study area. I refer to this endeavour as 'ecological *glasnost*' — a willingness to make information on environmental impact available to the public. Training local language-speaking liaison officers may assist in this process.

Long-Term Prospects

At current rates of production, there are nearly two decades of ore left at Mount Fubilan. If OTML wants to stay in operation for the duration, it must give these measures the highest priority:

- to rehabilitate the damages already incurred along the Ok Tedi and Fly rivers;
- to improve compensation procedures so that residents and landowners receive appropriate recompense for the losses they have sustained;
- to improve relations and communication with local communities; and
- to reduce the volume of sediment and mine tailings released into the Ok Tedi and Fly River system.

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