Ritual Regulation of Environmental Relations Among a New Guinea People[1]

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Most functional studies of religious behavior in anthropology have as an analytic goal the elucidation of events, processes, or relationships occurring within a social unit of some sort. The social unit is not always well defined, but in some cases it appears to be a church, that is, a group of people who entertain similar beliefs about the universe, or a congregation, a group of people who participate together in the performance of religious rituals. There have been exceptions. Thus Vayda, Leeds, and Smith (1961) and O. K. Moore (1957) have clearly perceived that the functions of religious ritual are not necessarily confined within the boundaries of a congregation or even a church. By and large, however, I believe that the following statement by Homans (1941: 172) represents fairly the dominant line of anthropological thought concerning the functions of religious ritual:

> Ritual actions do not produce a practical result on the external world—that is one of the reasons why we call them ritual. But to make this statement is not to say that ritual has no function. Its function is not related to the world external to the society but to the internal constitution of the society. It gives the members of the society confidence, it dispels their anxieties, it disciplines their social organization.

No argument will be raised here against the sociological and psychological functions imputed by Homans, and many others before him, to ritual. They seem to me to be plausible. Nevertheless, in some cases at least, ritual does produce, in Homans' terms, "a practical result on the world" external not only to the social unit composed of those who participate together in ritual performances but also to the larger unit composed of those who entertain similar beliefs concerning the universe. The material presented here will show that the ritual cycles of the Tsembaga, and of other local territorial groups of Maring speakers living in the New Guinea interior, play an important part in regulating the relationships of these groups with both the nonhuman components of their immediate environments and the human components of their less immediate environments, that is, with other similar territorial groups. To be more specific, this regulation helps to maintain the biotic communities existing within their territories, redistributes land

among people and people over land, and limits the frequency of fighting. In the absence of authoritative political statuses or offices, the ritual cycle likewise provides a means for mobilizing allies when warfare may be undertaken. It also provides a mechanism for redistributing local pig surpluses in the form of pork throughout a large regional population while helping to assure the local population of a supply of pork when its members are most in need of high quality protein.

Religious ritual may be defined, for the purposes of this paper, as the prescribed performance of conventionalized acts manifestly directed toward the involvement of nonempirical or supernatural agencies in the affairs of the actors. While this definition relies upon the formal characteristics of the performances and upon the motives for undertaking them, attention will be focused upon the empirical effects of ritual performances and sequences of ritual performances. The religious rituals to be discussed are regarded as neither more nor less than part of the behavioral repertoire employed by an aggregate of organisms in adjusting to its environment.

The data upon which this paper is based were collected during fourteen months of field work among the Tsembaga, one of about twenty local groups of Maring speakers living in the Simbai and Jimi Valleys of the Bismarck Range in the Territory of New Guinea. The size of Maring local groups varies from a little over 100 to 900. The Tsembaga, who in 1963 numbered 204 persons, are located on the south wall of the Simbai Valley. The country in which they live differs from the true highlands in being lower, generally more rugged, and more heavily forested. Tsembaga territory rises, within a total surface area of 3.2 square miles, from an elevation of 2,200 feet at the Simbai river to 7,200 feet at the ridge crest. Gardens are cut in the secondary forests up to between 5,000 and 5,400 feet, above which the area remains in primary forest. Rainfall reaches 150 inches per year.

The Tsembaga have come into contact with the outside world only recently; the first government patrol to penetrate their territory arrived in 1954. They were considered uncontrolled by the Australian government until 1962, and they remain unmissionized to this day.

The 204 Tsembaga are distributed among five putatively patrilineal clans, which are, in turn, organized into more inclusive groupings on two hierarchical levels below that of the total local group.[2] Internal political structure is highly egalitarian. There are no hereditary or elected chiefs, nor are there even "big men" who can regularly coerce or command the support of their clansmen or co-residents in economic or forceful enterprises.

It is convenient to regard the Tsembaga as a population in the ecological sense, that is, as one of the components of a system of trophic exchanges taking place within a bounded area. Tsembaga territory and the biotic community existing upon it may be conveniently viewed as an ecosystem. While it would be permissible arbitrarily to designate the Tsembaga as a population and their territory with its biota as an ecosystem, there are also nonarbitrary reasons for doing so. An ecosystem is a system of material exchanges, and the Tsembaga maintain against other human groups exclusive access to the resources within their territorial borders. Conversely, it is from

this territory alone that the Tsembaga ordinarily derive all of their foodstuffs and most of the other materials they require for survival. Less anthropocentrically, it may be justified to regard Tsembaga territory with its biota as an ecosystem in view of the rather localized nature of cyclical material exchanges in tropical rainforests.

As they are involved with the nonhuman biotic community within their territory in a set of trophic exchanges, so do they participate in other material relationships with other human groups external to their territory. Genetic materials are exchanged with other groups, and certain crucial items, such as stone axes, were in past obtained from the outside. Furthermore, in the area occupied by the Maring speakers, more than one local group is usually involved in any process, either peaceful or warlike, through which people are redistributed over land and land redistributed among people.

The concept of the ecosystem, though it provides a convenient frame for the analysis of interspecific trophic exchanges taking place within limited geographical areas, does not comfortably accommodate intraspecific exchanges taking place over wider geographic areas. Some sort of geographic population model would be more useful for the analysis of the relationship of the local ecological population to the larger regional population of which it is a part, but we lack even a set of appropriate terms for such a model. Suffice it here to note that the relations of the Tsembaga to the total of other local human populations in their vicinity are similar to the relations of local aggregates of other animals to the totality of their species occupying broader and more or less continuous regions. This larger, more inclusive aggregate may resemble what geneticists mean by the term population, that is, an aggregate of interbreeding organisms persisting through an indefinite number of generations and either living or capable of living in isolation from similar aggregates of the same species. This is the unit which survives through long periods of time while its local ecological (*sensu stricto*) subunits, the units more or less independently involved in interspecific trophic exchanges such as the Tsembaga, are ephemeral.

Since it has been asserted that the ritual cycles of the Tsembaga regulate relationships within what may be regarded as a complex system, it is necessary, before proceeding to the ritual cycle itself, to describe briefly, and where possible in quantitative terms, some aspects of the place of the Tsembaga in this system.

The Tsembaga are bush-fallowing horticulturalists. Staples include a range of root crops, taro (*Colocasia*) and sweet potatoes being most important, yams and manioc less so. In addition, a great variety of greens are raised, some of which are rich in protein. Sugar cane and some tree crops, particularly *Pandanus conoideus,* are also important.

All gardens are mixed, many of them containing all of the major root crops and many greens. Two named garden types are, however, distinguished by the crops which predominate in them. "Taro-yam gardens" were found to produce, on the basis of daily harvest records kept on entire gardens for close to one year, about 5,300,000 calories[3] per acre during their harvesting lives of 18 to 24 months; 85 per cent of their yield is harvested

between 24 and 76 weeks after planting. "Sugar-sweet potato gardens" produce about 4,600,000 calories per acre during their harvesting lives, 91 per cent being taken between 24 and 76 weeks after planting. I estimated that approximately 310,000 calories per acre is expended on cutting, fencing, planting, maintaining, harvesting, and walking to and from taro-yam gardens. Sugar-sweet potato gardens required an expenditure of approximately 290,000 calories per acre.[4] These energy ratios, approximately 17:1 on taro-yam gardens and 16:1 on sugar-sweet potato gardens, compare favorably with figures reported for swidden cultivation in other regions.[5]

Intake is high in comparison with the reported dietaries of other New Guinea populations. On the basis of daily consumption records kept for ten months on four households numbering in total sixteen persons, I estimated the average daily intake of adult males to be approximately 2,600 calories, and that of adult females to be around 2,200 calories. It may be mentioned here that the Tsembaga are small and short statured. Adult males average 101 pounds in weight and approximately 58.5 inches in height; the corresponding averages for adult females are 85 pounds and 54.5 inches.[6]

Although 99 per cent by weight of the food consumed is vegetable, the protein intake is high by New Guinea standards. The daily protein consumption of adult males from vegetable sources was estimated to be between 43 and 55 grams, of adult females 36 to 48 grams. Even with an adjustment for vegetable sources, these values are slightly in excess of the recently published WHO/FAO daily requirements (Food and Agriculture Organization of the United Nations 1964). The same is true of the younger age categories, although soft and discolored hair, a symptom of protein deficiency, was noted in a few children. The WHO/FAO protein requirements do not include a large "margin for safety" or allowance for stress; and, although no clinical assessments were undertaken, it may be suggested that the Tsembaga achieve nitrogen balance at a low level. In other words, their protein intake is probably marginal.

Measurements of all gardens made during 1962 and of some gardens made during 1963 indicate that, to support the human population, between .15 and .19 acres are put into cultivation per capita per year. Fallows range from 8 to 45 years. The area in secondary forest comprises approximately 1,000 acres, only 30 to 50 of which are in cultivation at any time. Assuming calories to be the limiting factor, and assuming an unchanging population structure, the territory could support—with no reduction in lengths of fallow and without cutting into the virgin forest from which the Tsembaga extract many important items—between 290 and 397 people if the pig population remained minimal. The size of the pig herd, however, fluctuates widely. Taking Maring pig husbandry procedures into consideration, I have estimated the human carrying capacity of the Tsembaga territory at between 270 and 320 people.

Because the timing of the ritual cycle is bound up with the demography of the pig herd, the place of the pig in Tsembaga adaptation must be examined.

First, being omnivorous, pigs keep residential areas free of garbage and human feces. Second, limited numbers of pigs rooting in secondary growth

may help to hasten the development of that growth. The Tsembaga usually permit pigs to enter their gardens one and a half to two years after planting, by which time second-growth trees are well established there. The Tsembaga practice selective weeding; from the time the garden is planted, herbaceous species are removed, but tree species are allowed to remain. By the time cropping is discontinued and the pigs are let in, some of the trees in the garden are already ten to fifteen feet tall. These well-established trees are relatively impervious to damage by the pigs, which, in rooting for seeds and remaining tubers, eliminate many seeds and seedlings that, if allowed to develop, would provide some competition for the established trees. Moreover, in some Maring-speaking areas swiddens are planted twice, although this is not the case with the Tsembaga. After the first crop is almost exhausted, pigs are penned in the garden, where their rooting eliminates weeds and softens the ground, making the task of planting for a second time easier. The pigs, in other words, are used as cultivating machines.

Small numbers of pigs are easy to keep. They run free during the day and return home at night to receive their ration of garbage and substandard tubers, particularly sweet potatoes. Supplying the latter requires little extra work, for the substandard tubers are taken from the ground in the course of harvesting the daily ration for humans. Daily consumption records kept over a period of some months show that the ration of tubers received by the pigs approximates in weight that consumed by adult humans, i.e., a little less than three pounds per day per pig.

If the pig herd grows large, however, the substandard tubers incidentally obtained in the course of harvesting for human needs become insufficient, and it becomes necessary to harvest especially for pigs. In other words, people must work for the pigs and perhaps even supply them with food fit for human consumption. Thus, as Vayda, Leeds, and Smith (1961: 71) have pointed out, there can be too many pigs for a given community.

This also holds true of the sanitary and cultivating services rendered by pigs. A small number of pigs is sufficient to keep residential areas clean, to suppress superfluous seedlings in abandoned gardens, and to soften the soil in gardens scheduled for second plantings. A larger herd, on the other hand, may be troublesome; the larger the number of pigs, the greater the possibility of their invasion of producing gardens, with concomitant damage not only to crops and young secondary growth but also to the relations between the pig owners and garden owners.

All male pigs are castrated at approximately three months of age, for boars, people say, are dangerous and do not grow as large as barrows. Pregnancies, therefore, are always the result of unions of domestic sows with feral males. Fecundity is thus only a fraction of its potential. During one twelve-month period only fourteen litters resulted out of a potential 99 or more pregnancies. Farrowing generally takes place in the forest, and mortality of the young is high. Only 32 of the offspring of the above-mentioned fourteen pregnancies were alive six months after birth. This number is barely sufficient to replace the number of adult animals which would have died or been killed during most years without pig festivals.

The Tsembaga almost never kill domestic pigs outside of ritual contexts. In ordinary times, when there is no pig festival in progress, these rituals are almost always associated with misfortunes or emergencies, notably warfare, illness, injury, or death. Rules state not only the contexts in which pigs are to be ritually slaughtered, but also who may partake of the flesh of the sacrificial animals. During warfare it is only the men participating in the fighting who eat the pork. In cases of illness or injury, it is only the victim and certain near relatives, particularly his co-resident agnates and spouses, who do so.

It is reasonable to assume that misfortune and emergency are likely to induce in the organisms experiencing them a complex of physiological changes known collectively as "stress." Physiological stress reactions occur not only in organisms which are infected with disease or traumatized, but also in those experiencing rage or fear (Houssay *et al.* 1955: 1096), or even prolonged anxiety (National Research Council 1963: 53). One important aspect of stress is the increased catabolization of protein (Houssay *et al.* 1955: 451; National Research Council 1963: 49), with a net loss of nitrogen from the tissues (Houssay *et al.* 1955: 450). This is a serious matter for organisms with a marginal protein intake. Antibody production is low (Berg 1948: 311), healing is slow (Large and Johnston 1948: 352), and a variety of symptoms of a serious nature are likely to develop (Lund and Levenson 1948: 349; Zintel 1964: 1043). The status of a protein-depleted animal, however, may be significantly improved in a relatively short period of time by the intake of high quality protein, and high protein diets are therefore routinely prescribed for surgical patients and those suffering from infectious diseases (Burton 1959: 231; Lund and Levenson 1948: 350; Elman 1951: 85ff; Zintel 1964: 1043ff).

It is precisely when they are undergoing physiological stress that the Tsembaga kill and consume their pigs, and it should be noted that they limit the consumption to those likely to be experiencing stress most profoundly. The Tsembaga, of course, know nothing of physiological stress. Native theories of the etiology and treatment of disease and injury implicate various categories of spirits to whom sacrifices must be made. Nevertheless, the behavior which is appropriate in terms of native understandings is also appropriate to the actual situation confronting the actors.

We may now outline in the barest of terms the Tsembaga ritual cycle. Space does not permit a description of its ideological correlates. It must suffice to note that Tsembaga do not necessarily perceive all of the empirical effects which the anthropologist sees to flow from their ritual behavior. Such empirical consequences as they may perceive, moreover, are not central to their rationalizations of the performances. The Tsembaga say that they perform the rituals in order to rearrange their relationships with the supernatural world. We may only reiterate here that behavior undertaken in reference to their "cognized environment"—an environment which includes as very important elements the spirits of ancestors—seems appropriate in their "operational environment," the material environment specified by the anthropologist through operations of observation, including measurement.

Since the rituals are arranged in a cycle, description may commence at any point. The operation of the cycle becomes clearest if we begin with the rituals performed during warfare. Opponents in all cases occupy adjacent territories, in almost all cases on the same valley wall. After hostilities have broken out, each side performs certain rituals which place the opposing side in the formal category of "enemy." A number of taboos prevail while hostilities continue. These include prohibitions on sexual intercourse and on the ingestion of certain things—food prepared by women, food grown on the lower portion of the territory, marsupials, eels, and, while actually on the fighting ground, any liquid whatsoever.

One ritual practice associated with fighting which may have some physiological consequences deserves mention. Immediately before proceeding to the fighting ground, the warriors eat heavily salted pig fat. The ingestion of salt, coupled with the taboo on drinking, has the effect of shortening the fighting day, particularly since the Maring prefer to fight only on bright sunny days. When everyone gets unbearably thirsty, according to informants, fighting is broken off.

There may formerly have been other effects if the native salt contained sodium (the production of salt was discontinued some years previous to the field work, and no samples were obtained). The Maring diet seems to be deficient in sodium. The ingestion of large amounts of sodium just prior to fighting would have permitted the warriors to sweat normally without a lowering of blood volume and consequent weakness during the course of the fighting. The pork belly ingested with the salt would have provided them with a new burst of energy two hours or so after the commencement of the engagement. After fighting was finished for the day, lean pork was consumed, offsetting, at least to some extent, the nitrogen loss associated with the stressful fighting (personal communications from F. Dunn, W. MacFarlane, and J. Sabine, 1965).

Fighting could continue sporadically for weeks. Occasionally it terminated in the rout of one of the antagonistic groups, whose survivors would take refuge with kinsmen elsewhere. In such instances, the victors would lay waste their opponents' groves and gardens, slaughter their pigs, and burn their houses. They would not, however, immediately annex the territory of the vanquished. The Maring say that they never take over the territory of an enemy for, even if it has been abandoned, the spirits of their ancestors remain to guard it against interlopers. Most fights, however, terminated in truces between the antagonists.

With the termination of hostilities a group which has not been driven off its territory performs a ritual called "planting the *rumbim*." Every man puts his hand on the ritual plant, *rumbim* (*Cordyline fruticosa* (L.), A. Chev; *C. terminalis,* Kunth), as it is planted in the ground. The ancestors are addressed, in effect, as follows:

> We thank you for helping us in the fight and permitting us to remain on our territory. We place our souls in this *rumbim* as we plant it on our ground. We ask you to care for this *rumbim*. We will kill pigs for you now, but they are few. In the future, when we have many pigs, we shall again give you pork and uproot the *rumbim* and stage a

ḳaiḳo (pig festival). But until there are sufficient pigs to repay you the *rumbim* will remain in the ground.

This ritual is accompanied by the wholesale slaughter of pigs. Only juveniles remain alive. All adult and adolescent animals are killed, cooked, and dedicated to the ancestors. Some are consumed by the local group, but most are distributed to allies who assisted in the fight.

Some of the taboos which the group suffered during the time of fighting are abrogated by this ritual. Sexual intercourse is now permitted, liquids may be taken at any time, and food from any part of the territory may be eaten. But the group is still in debt to its allies and ancestors. People say it is still the time of the *bamp ḳu,* or "fighting stones," which are actual objects used in the rituals associated with warfare. Although the fighting ceases when *rumbim* is planted, the concomitant obligations, debts to allies and ancestors, remain outstanding; and the fighting stones may not be put away until these obligations are fulfilled. The time of the fighting stones is a time of debt and danger which lasts until the *rumbim* is uprooted and a pig festival (*ḳaiḳo*) is staged.

Certain taboos persist during the time of the fighting stones. Marsupials, regarded as the pigs of the ancestors of the high ground, may not be trapped until the debt to their masters has been repaid. Eels, the "pigs of the ancestors of the low ground," may neither be caught nor consumed. Prohibitions on all intercourse with the enemy come into force. One may not touch, talk to, or even look at a member of the enemy group, nor set foot on enemy ground. Even more important, a group may not attack another group while its ritual plant remains in the ground, for it has not yet fully rewarded its ancestors and allies for their assistance in the last fight. Until the debts to them have been paid, further assistance from them will not be forthcoming. A kind of "truce of god" thus prevails until the *rumbim* is uprooted and a *ḳaiḳo* completed.

To uproot the *rumbim* requires sufficient pigs. How many pigs are sufficient, and how long does it take to acquire them? The Tsembaga say that, if a place is "good," this can take as little as five years; but if a place is "bad," it may require ten years or longer. A bad place is one in which misfortunes are frequent and where, therefore, ritual demands for the killing of pigs arise frequently. A good place is one where such demands are infrequent. In a good place, the increase of the pig herd exceeds the ongoing ritual demands, and the herd grows rapidly. Sooner or later the substandard tubers incidentally obtained while harvesting become insufficient to feed the herd, and additional acreage must be put into production specifically for the pigs.

The work involved in caring for a large pig herd can be extremely burdensome. The Tsembaga herd just prior to the pig festival of 1962-63, when it numbered 169 animals, was receiving 54 per cent of all of the sweet potatoes and 82 per cent of all of the manioc harvested. These comprised 35.9 per cent by weight of all root crops harvested. This figure is consistent with the difference between the amount of land under cultivation just previous to the pig festival, when the herd was at maximum size, and that immediately

afterwards, when the pig herd was at minimum size. The former was 36.1 per cent in excess of the latter.

I have estimated, on the basis of acreage yield and energy expenditure figures, that about 45,000 calories per year are expended in caring for one pig 120-150 pounds in size. It is upon women that most of the burden of pig keeping falls. If, from a woman's daily intake of about 2,200 calories, 950 calories are allowed for basal metabolism, a woman has only 1,250 calories a day available for all her activities, which include gardening for her family, child care, and cooking, as well as tending pigs. It is clear that no woman can feed many pigs; only a few had as many as four in their care at the commencement of the festival; and it is not surprising that agitation to uproot the *rumbim* and stage the *kaiko* starts with the wives of the owners of large numbers of pigs.

A large herd is not only burdensome as far as energy expenditure is concerned; it becomes increasingly a nuisance as it expands. The more numerous pigs become, the more frequently are gardens invaded by them. Such events result in serious disturbances of local tranquillity. The garden owner often shoots, or attempts to shoot, the offending pig; and the pig owner commonly retorts by shooting, or attempting to shoot, either the garden owner, his wife, or one of his pigs. As more and more such events occur, the settlement, nucleated when the herd was small, disperses as people try to put as much distance as possible between their pigs and other people's gardens and between their gardens and other people's pigs. Occasionally this reaches its logical conclusion, and people begin to leave the territory, taking up residence with kinsmen in other local populations.

The number of pigs sufficient to become intolerable to the Tsembaga was below the capacity of the territory to carry pigs. I have estimated that, if the size and structure of the human population remained constant at the 1962-1963 level, a pig population of 140 to 240 animals averaging 100 to 150 pounds in size could be maintained perpetually by the Tsembaga without necessarily inducing environmental degradation. Since the size of the herd fluctuates, even higher cyclical maxima could be achieved. The level of toleration, however, is likely always to be below the carrying capacity, since the destructive capacity of the pigs is dependent upon the population density of both people and pigs, rather than upon population size. The denser the human population, the fewer pigs will be required to disrupt social life. If the carrying capacity is exceeded, it is likely to be exceeded by people and not by pigs.

The *kaiko* or pig festival, which commences with the planting of stakes at the boundary and the uprooting of the *rumbim,* is thus triggered by either the additional work attendant upon feeding pigs or the destructive capacity of the pigs themselves. It may be said, then, that there are sufficient pigs to stage the *kaiko* when the relationship of pigs to people changes from one of mutualism to one of parasitism or competition.

A short time prior to the uprooting of the *rumbim,* stakes are planted at the boundary. If the enemy has continued to occupy its territory, the stakes are planted at the boundary which existed before the fight. If, on the other hand, the enemy has abandoned its territory, the victors may plant their

stakes at a new boundary which encompasses areas previously occupied by the enemy. The Maring say, to be sure, that they never take land belonging to an enemy, but this land is regarded as vacant, since no *rumbim* was planted on it after the last fight. We may state here a rule of land redistribution in terms of the ritual cycle: *If one of a pair of antagonistic groups is able to uproot its rumbim before its opponents can plant their rumbim, it may occupy the latter's territory.*

Not only have the vanquished abandoned their territory; it is assumed that it has also been abandoned by their ancestors as well. The surviving members of the erstwhile enemy group have by this time resided with other groups for a number of years, and most if not all of them have already had occasion to sacrifice pigs to their ancestors at their new residences. In so doing they have invited these spirits to settle at the new locations of the living, where they will in the future receive sacrifices. Ancestors of vanquished groups thus relinquish their guardianship over the territory, making it available to victorious groups. Meanwhile, the *de facto* membership of the living in the groups with which they have taken refuge is converted eventually into *de jure* membership. Sooner or later the groups with which they have taken up residence will have occasion to plant *rumbim,* and the refugees, as coresidents, will participate, thus ritually validating their connection to the new territory and the new group. A rule of population redistribution may thus be stated in terms of ritual cycles: *A man becomes a member of a territorial group by participating with it in the planting of rumbim.*

The uprooting of the *rumbim* follows shortly after the planting of stakes at the boundary. On this particular occasion the Tsembaga killed 32 pigs out of their herd of 169. Much of the pork was distributed to allies and affines outside of the local group.

The taboo on trapping marsupials was also terminated at this time. Information is lacking concerning the population dynamics of the local marsupials, but it may well be that the taboo which had prevailed since the last fight—that against taking them in traps—had conserved a fauna which might otherwise have become extinct.

The *ƙaiƙo* continues for about a year, during which period friendly groups are entertained from time to time. The guests receive presents of vegetable foods, and the hosts and male guests dance together throughout the night.

These events may be regarded as analogous to aspects of the social behavior of many nonhuman animals. First of all, they include massed epigamic, or courtship, displays (Wynne-Edwards 1962: 17). Young women are presented with samples of the eligible males of local groups with which they may not otherwise have had the opportunity to become familiar. The context, moreover, permits the young women to discriminate amongst this sample in terms of both endurance (signaled by how vigorously and how long a man dances) and wealth (signaled by the richness of a man's shell and feather finery).

More importantly, the massed dancing at these events may be regarded as epideictic display, communicating to the participants information concerning the size or density of the group (Wynne-Edwards 1962: 16). In many species

such displays take place as a prelude to actions which adjust group size or density, and such is the case among the Maring. The massed dancing of the visitors at a *kaiko* entertainment communicates to the hosts, while the *rumbim* truce is still in force, information concerning the amount of support they may expect from the visitors in the bellicose enterprises that they are likely to embark upon soon after the termination of the pig festival.

Among the Maring there are no chiefs or other political authorities capable of commanding the support of a body of followers, and the decision to assist another group in warfare rests with each individual male. Allies are not recruited by appealing for help to other local groups as such. Rather, each member of the groups primarily involved in the hostilities appeals to his cognatic and affinal kinsmen in other local groups. These men, in turn, urge other of their co-residents and kinsmen to "help them fight." The channels through which invitations to dance are extended are precisely those through which appeals for military support are issued. The invitations go not from group to group, but from kinsman to kinsman, the recipients of invitations urging their co-residents to "help them dance."

Invitations to dance do more than exercise the channels through which allies are recruited; they provide a means for judging their effectiveness. Dancing and fighting are regarded as in some sense equivalent. This equivalence is expressed in the similarity of some pre-fight and pre-dance rituals, and the Maring say that those who come to dance come to fight. The size of a visiting dancing contingent is consequently taken as a measure of the size of the contingent of warriors whose assistance may be expected in the next round of warfare.

In the morning the dancing ground turns into a trading ground. The items most frequently exchanged include axes, bird plumes, shell ornaments, an occasional baby pig, and, in former times, native salt. The *kaiko* thus facilitates trade by providing a market-like setting in which large numbers of traders can assemble. It likewise facilitates the movement of two critical items, salt and axes, by creating a demand for the bird plumes which may be exchanged for them.

The *kaiko* concludes with major pig sacrifices. On this particular occasion the Tsembaga butchered 105 adult and adolescent pigs, leaving only 60 juveniles and neonates alive. The survival of an additional fifteen adolescents and adults was only temporary, for they were scheduled as imminent victims. The pork yielded by the Tsembaga slaughter was estimated to weigh between 7,000 and 8,500 pounds, of which between 4,500 and 6,000 pounds were distributed to members of other local groups in 163 separate presentations. An estimated 2,000 to 3,000 people in seventeen local groups were the beneficiaries of the redistribution. The presentations, it should be mentioned, were not confined to pork. Sixteen Tsembaga men presented bridewealth or child-wealth, consisting largely of axes and shells, to their affines at this time.

The *kaiko* terminates on the day of the pig slaughter with the public presentation of salted pig belly to allies of the last fight. Presentations are made through the window in a high ceremonial fence built specially for the oc-

casion at one end of the dance ground. The name of each honored man is announced to the assembled multitude as he charges to the window to receive his hero's portion. The fence is then ritually torn down, and the fighting stones are put away. The pig festival and the ritual cycle have been completed, demonstrating, it may be suggested, the ecological and economic competence of the local population. The local population would now be free, if it were not for the presence of the government, to attack its enemy again, secure in the knowledge that the assistance of allies and ancestors would be forthcoming because they have received pork and the obligations to them have been fulfilled.

Usually fighting did break out again very soon after the completion of the ritual cycle. If peace still prevailed when the ceremonial fence had rotted completely—a process said to take about three years, a little longer than the length of time required to raise a pig to maximum size—*rumbim* was planted as if there had been a fight, and all adult and adolescent pigs were killed. When the pig herd was large enough so that the *rumbim* could be uprooted, peace could be made with former enemies if they were also able to dig out their *rumbim*. To put this in formal terms: *If a pair of antagonistic groups proceeds through two ritual cycles without resumption of hostilities their enmity may be terminated.*

The relations of the Tsembaga with their environment have been analyzed as a complex system composed of two subsystems. What may be called the "local subsystem" has been derived from the relations of the Tsembaga with the nonhuman components of their immediate or territorial environment. It corresponds to the ecosystem in which the Tsembaga participate. A second subsystem, one which corresponds to the larger regional population of which the Tsembaga are one of the constituent units and which may be designated as the "regional subsystem," has been derived from the relations of the Tsembaga with neighboring local populations similar to themselves.

It has been argued that rituals, arranged in repetitive sequences, regulate relations both within each of the subsystems and within the larger complex system as a whole. The timing of the ritual cycle is largely dependent upon changes in the states of the components of the local subsystem. But the *kaiko,* which is the culmination of the ritual cycle, does more than reverse changes which have taken place within the local subsystem. Its occurrence also affects relations among the components of the regional subsystem. During its performance, obligations to other local populations are fulfilled, support for future military enterprises is rallied, and land from which enemies have earlier been driven is occupied. Its completion, furthermore, permits the local population to initiate warfare again. Conversely, warfare is terminated by rituals which preclude the reinitiation of warfare until the state of the local subsystem is again such that a *kaiko* may be staged and completed. Ritual among the Tsembaga and other Maring, in short, operates as both transducer, "translating" changes in the state of one subsystem into information which can effect changes in a second subsystem, and homeostat, maintaining a number of variables which in sum comprise the total system within ranges of viability. To repeat an earlier assertion, the operation of ritual among the

Tsembaga and other Maring helps to maintain an undegraded environment, limits fighting to frequencies which do not endanger the existence of the regional population, adjusts man-land ratios, facilitates trade, distributes local surpluses of pig throughout the regional population in the form of pork, and assures people of high quality protein when they are most in need of it.

Religious rituals and the supernatural orders toward which they are directed cannot be assumed *a priori* to be mere epiphenomena. Ritual may, and doubtless frequently does, do nothing more than validate and intensify the relationships which integrate the social unit, or symbolize the relationships which bind the social unit to its environment. But the interpretation of such presumably *sapiens*-specific phenomena as religious ritual within a framework which will also accommodate the behavior of other species shows, I think, that religious ritual may do much more than symbolize, validate, and intensify relationships. Indeed, it would not be improper to refer to the Tsembaga and the other entities with which they share their territory as a "ritually regulated ecosystem," and to the Tsembaga and their human neighbors as a "ritually regulated population."

NOTES

1. The field work upon which this paper is based was supported by a grant from the National Science Foundation, under which Professor A. P. Vayda was principal investigator. Personal support was received by the author from the National Institutes of Health. Earlier versions of this paper were presented at the 1964 annual meeting of the American Anthropological Association in Detroit, and before a Columbia University seminar on Ecological Systems and Cultural Evolution. I have received valuable suggestions from Alexander Alland, Jacques Barrau, William Clarke, Paul Collins, C. Glen King, Marvin Harris, Margaret Mead, M. J. Meggitt, Ann Rappaport, John Street, Marjorie Whiting, Cherry Vayda, A. P. Vayda and many others, but I take full responsibility for the analysis presented herewith.

2. The social organization of the Tsembaga will be described in detail elsewhere.

3. Because the length of time in the field precluded the possibility of maintaining harvest records on single gardens from planting through abandonment, figures were based, in the case of both "taro-yam" and "sugar-sweet potato" gardens, on three separate gardens planted in successive years. Conversions from the gross weight to the caloric value of yields were made by reference to the literature. The sources used are listed in Rappaport (1966: Appendix VIII)

4. Rough time and motion studies of each of the tasks involved in making, maintaining, harvesting, and walking to and from gardens were undertaken. Conversion to energy expenditure values was accomplished by reference to energy expenditure tables prepared by Hipsley and Kirk (1965: 43) on the basis of gas exchange measurements made during the performance of garden tasks by the Chimbu people of the New Guinea highlands.

5. Marvin Harris, in an unpublished paper, estimates the ratio of energy return to energy input ratio on Dyak (Borneo) rice swiddens at 10:1. His estimates of energy ratios on Tepotzlan (Meso-America) swiddens range from 13:1 on poor land to 29:1 on the best land.

6. Heights may be inaccurate. Many men wear their hair in large coiffures hardened with pandanus grease, and it was necessary in some instances to estimate the location of the top of the skull.

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