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Termites and Termite Mounds: Some Selected Observations*

by

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Keywords. — Termites; Termite Mounds; Typology; Africa; Termitophagy; Proverbs.

Summary. — The paper sets out to explore "termites and termite mounds". Eight aspects will be considered: (1) termites and termite mounds; (2) termites as major agents of the pedofauna in several tropical macro-ecosystems and their profoundly disrupting behaviour; (3) termite mounds as key features in the landscape, presenting an astonishing local typology; (4) termite mounds as a particular habitat, a well-differentiated sub-ecosystem, hosting some species belonging to several kingdoms whose distribution is restricted to this habitat; (5) the diversity of termitophagy; (6) the importance of termites in building towns and for other uses of termite mounds; (7) the diverse cultural perceptions of termites, *i.e.* their place in religion, myths, their medicinal use, and the methods used to catch them. Finally, and importantly, (8) termites and termite mounds as a source of wisdom, indicated by more than two hundred proverbs recorded in more than sixty different languages.

Mots-clés. — Termites; Termitières; Typologie; Afrique; Termitophagie; Proverbes.

Résumé. — *Termites et termitières: quelques observations choisies.* — L'article se propose d'étudier sous divers aspects le binôme «termites et termitières». Huit thèmes seront considérés: (1) les termites et les termitières; (2) les termites comme agents majeurs de la pédofaune de plusieurs macroécosystèmes tropicaux et comme bioturbateurs incontournables; (3) les termitières comme marqueurs du paysage et présentant une typologie locale étonnante; (4) les termitières comme habitat particulier, un sous-écosystème bien différencié, hébergeant quelques espèces relevant de divers règnes et à distribution limitée à cet habitat; (5) la diversité de la termitophagie; (6) l'importance des termites comme bâtisseurs de villes et autres usages des termitières; (7) les diverses perceptions culturelles des termites, à savoir leur place dans les religions, mythes, leur usage médicinal, les techniques de capture. Enfin, *last but not least*, (8) les termites et termitières comme source de sagesse, ainsi qu'attesté par plus de deux cents proverbes enregistrés dans plus de soixante langues différentes.

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1. Introduction

Termites are eusocial insects, with two pairs of almost similar membranous wings. The term *tarmes* or *termes*, *i.e.* “rodent worm” in early Latin, was used by the Romans. For many years they belonged to the Isoptera Order comprising twelve families (Myles 1998). Recently, they became a suborder, namely the Isopteroidea of the Blattoptera Order. Today it is suggested that they belong to the epifamily of Termitoidea. Some three thousand one hundred and six species are currently described, with a few hundred more still to be described (Bignell *et al.* 2010). For tropical Africa (North Africa and Madagascar excluded) five of the seven families, one hundred and twelve of the two hundred eighty genera and six hundred and sixty-nine species have so far been listed (Deligne, pers. comm.).

Termites have a particular life cycle; larva (or young nymph) may evolve into worker, soldier or alate imago (or reproductive). Reproductives (queen and king), after a short nuptial flight, will lose their wings and find a new colony, the queen producing eggs (fig. 1).

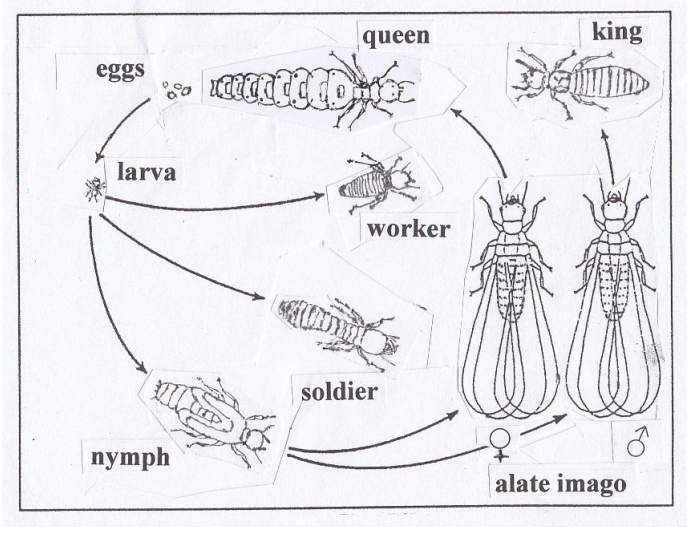


Fig. 1. — Termite cycle.

Classification of termites is based on diverse characteristics, notably the presence or absence of a frontal gland — ocellus — of symbiotic zooflagellates in the rectal paunch or of symbiotic bacteria, the number of segments on the tarsus (four, four-five or five) and the number of segments on the antennas of imagos.

Classification of termites is evolving and several approaches exist. For instance, the epifamily Termitoidae is composed, according to authors, of seven to eleven families (notably the Termitidae, Rhinotermitidae, Kalotermididae, Termopsidae, Hodotermitidae, and Mastotermitidae). Fourteen subfamilies are rec-

ognized, four belonging to the Termitidae family, namely the Macrotermitinae, the Nasutitermitinae, the Apicotermitinae and the Termitinae (Kambhampati & Eggleton 2000).

The distribution of Termitoidae epifamily is basically tropical, that of the Macrotermitinae being paleotropical (fig. 2).

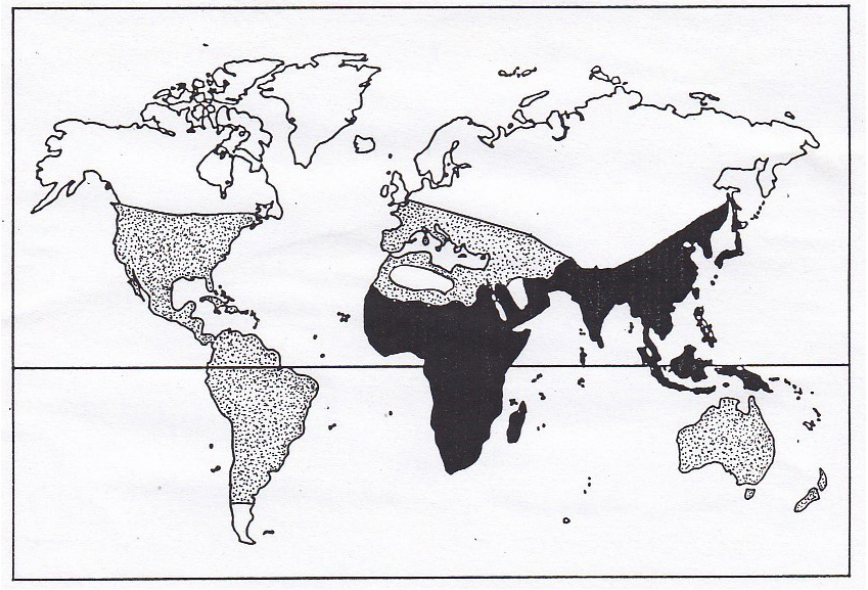


Fig. 2. — Distribution of the Termitoidae (grey: total area; black: Macrotermitidae).

For basic knowledge we suggest the book «Termites: Evolution, Sociability, Symbiosis, Ecology» edited by Abe *et al.* (2000) and further information provided by Bignell & Jones (2009). Recent keys for determination are available, for instance that provided by Kambhampati & Eggleton (2000).

Many examples given in the present paper concern South-Central Africa as a result of our personal experience, but fine studies concerning termites have been written for South America, South-East Asia and Oceania, as well as for Western Africa. Regarding these areas, the papers published by Martius (1994) for the Amazon, by Josens (1972), Lepage (1974) and Wood & Johnson (1986) for Western Africa, by Payne *et al.* (2015) for Southern Africa, by Abe (1978) for Western Malaysia, and by Collins (1979) for Sarawak are recommended.

Nevertheless, it appears that information and data concerning South-Central Africa, an area belonging to the Zambezian domain (White 1983), have frequently not been taken into account. For instance, in a list of sixty-three sites given by Bignell & Eggleton (2000) no mention was made of the Zambezian open forest. Eggleton (2000) pointed out that the literature on termite distribu-

tion patterns in Africa is large, but not comprehensive. None of the six papers quoted by him concerns South-Central Africa.

Last but not least, what observations need to be carried out in order to identify a termite? In «Quel est ce termite africain?» Bouillon & Mathot (1965) provided us with all the information required to identify species level (fig. 3). Moreover, this information was supported by twinty-five clear plates.

Finally, regarding Africa, the first book on the biology of termites had already been published by Smeathmann (1781).

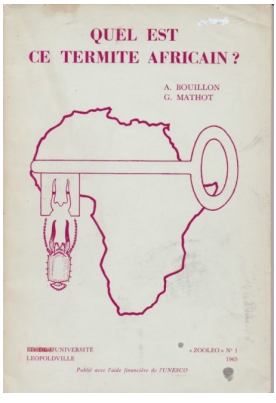


Fig. 3. — Cover of Bouillon & Mathot book.

Fig. 4. — Some accounts of the termites, which are found in Africa and other hot climates (15 February 1781).

2. Termites as Major Agents of the Pedofauna in Several Tropical Macro-ecosystems and also Profoundly Disrupting Insects

2.1. Termites are Major Agents of the Pedofauna

Termites feed on a wide range of organic materials, which they digest with the help of a specialized gut microflora. Generally five major and broadly overlapping feeding groups are recognized (Bignell & Eggleton 2000). These are (a) soil-feeders, (b) soil/wood interface-feeders, (c) wood-feeders, (d) litter-foragers and (e) grass-feeders. Some minor feeding groups exist: for instance some termites feed on fungi, algae and lichens, but these will not be covered in this study.

The activity of termites and the resulting consequences differ according to the groups quoted above. Only some examples can be briefly mentioned.

Some comments are given below concerning the population dynamics for the different phases of the life of a colony. For the Macrotermitinae, the initial stage

appears to be a highly critical step. In the first weeks, when the population of eggs, larvae, workers and soldiers increase, the total energy of the colony decreases continuously until about a hundred and thirty days, when the total population is about a hundred individuals (data for *Macrotermes michaelseni* after Lepage & Darlington 2000). After about three hundred days, with a population of two hundred and fifty/three hundred steriles, the total energy of the colony has regained its initial value. At this stage, the first brood of workers starts to forage and to build fungus comb. The population of the young nest grows rapidly and large numbers of eggs are laid by the queen. The beginning of the epigeal phase of the nest takes place about twenty months after the initial foundation (Lepage & Darlington 2000). Values of more and less three metres height are quoted within three years from first appearance.

Two more studies concerning the same genus have confirmed the wide range of issues dealt with. Girard & Lepage (1991) reported that the nest of *Macrotermes bellicosus* is at first hypogeous. During the first two years of its development, it moves up little by little above the soil. In its exponential phase, a relatively fast increase of nest volume is observed, the nest increasing by several m^3 per year, until it may reach three to six metres high. The nest is an enclosed environment, providing a particular microclimate. The whole of the nest is protected by a 3-5 mm thick covering, the "idiotheque". More than one thousand five hundred termitophilous species have been identified in colonies. The adult colony may be destroyed by specialized predators, of which Doryline ants are the most important. With the death of the termite mound, a compartment falls to the mercy of a multitude of lucifugous insects (mycophagous, sarcophagous and detritivorous), and also to their predators.

Regarding the large termite mounds built by *Macrotermes falciger*, the study carried out by Erens *et al.* (2015a) presents a totally different approach and also comes to a different conclusion. The age is estimated by radiocarbon dating of the organic matter of the central vertical mound axis. The study concerns two active and two abandoned mounds. If the age sequence in the active mounds is erratic, the results for the abandoned mounds show a logical increase of ^{14}C-age with depth. A warm period with high termite growth rates around 800-500 cal. yr BP is recognized. For further comments on African *Macrotermes,* see Ruelle (1970), Aloni *et al.* (1990), Pearce (1997) and Erens *et al.* (2015b).

2.2. Termites are Profoundly Disrupting Insects

The disrupting effect of termites' activity has been frequently observed. Termites' activity varies evidently according to the feeding groups and a detailed analysis of the effects of each group is not possible in this paper. However, as an example, we have chosen the soil-feeding termites. A review of them was provided by Brauman (2000). The diet of this feeding group is based on the consumption of the mineral containing horizons. The humic compounds ingested are

submitted, during a sequential transit, to different chemical and microbial processes. During the gut transit, the soil organic matter is strongly modified in terms of nature and organization. Other termites ingest soil and organic matter, regurgitate it and use it to plaster and build complex tunneling networks. Trophallaxis is also reported. It concerns, on the one hand, stomodeal food regurgitated from mouth to mouth and, on the other hand, proctodeal food produced by the anus and which consists of a liquid rich in flagellates, originating from the rectal paunch and playing an essential role in the digestion of cellulose.

The other disrupting aspect concerns carbonates. A study by Mujinya *et al.* (2011) indicates that carbonates occur predominantly as impregnative orthic nodules and less commonly as coatings. Carbonates are pedogenic precipitates, whose deposition is partly related to microbial decay of organic matter.

Concerning clay minerals, it has been established that some termites are weathering agents, notably in chamber walls and galleries (Jouquet *et al.* 2002). More recently the activity on clays, sesquioxides and water-dispersible clay content has also been studied from physico-chemical, mineralogical and micro-morphological approaches. The importance of the difference in moisture regime of termite mounds and surrounding soils was underlined (Mujinya *et al.* 2013). The fungus-growing termites increase notably the fine particles and organic matter in the mound soil. Moreover, their bioturbation has also effects on the electrochemical properties of ferralsols (Mujinya *et al.* 2010). The importance of available water as a critical factor during the dry season is pointed out (Cuma *et al.* 2018).

Bioturbation takes place at different levels, above soil in mounds, at surface level and finally at different depths in the soil. Regarding bioturbation above the soil, studies deal with the density of mounds per hectare, their mass quantification and real volume, their height, their composition, etc. Values vary considerably according to the ecosystems concerned from dense evergreen forest to open vegetation, but also according to building species. As an example we will take the dome-shaped mounds built by *Macrotermes falciger* in Upper Katanga. Their volume and mass quantification have already been studied (Aloni *et al.* 1981).

Concerning their density, the use of high-resolution aerial and satellite imagery, particularly free Google Earth images, has appeared as a satisfactory estimate on the on-site termite mound density (Vranken *et al.* 2014) (fig. 5). Values of 5.6 mounds per hectare, 5.1 m mean height and 31.0 m^2 mean basal area were measured in the field.

A recent study (Mujinya *et al.* 2014) has provided values of 2.9 ± 0.4 mounds per hectare, 4.12 m as the mean height, 14.69 m as the mean diameter. But the study was located in a peri-urban area profoundly disturbed by several decades of human activities.

Similar studies have been carried out on other species of other genera, for instance *Ancistrotermes* (Jouquet *et al.* 2003).

Fig. 5. — Aerial view of termite mounds taken at 1 km of Luano airport (Lubumbashi) in 1972. © F. Malaisse.

Concerning the small termite mounds built by *Cubitermes* spp., *Noditermes* sp., *Amitermes* spp., etc., Goffinet (1976) carried out a detailed study in open forest of miombo type near Lubumbashi and made similar observations in dry evergreen forest and shrub savannah. In open forest, he observed the presence of humivore termites (*Cubitermes* spp., *Noditermes* sp., *Megagnathotermes katangensis*, etc.), termites of degraded wood (*Amitermes* spp.) and fodder termites (*Trinervitermes dispar* and *Trinervitermes rhodesiensis*). In miombo, the small termite mounds occupy 66.8 $m^2.ha^{-1}$, of which 26.6 % are deserted. They number one thousand four hundred and sixty per hectare, of which 41.6 % are deserted. In miombo there are 10.4 million individual termites per hectare with a fresh weight of 31.13 $kg.ha^{-1}$ equivalent to 22.95 $kg.ha^{-1}$ dry weight.

More recently, in the same area, concerning *Cubitermes* spp., it has been stated that nest density is lower in open forest than in savannah, whilst four different species were identified, namely *Cubitermes ugandensis, C. orthognaus, C. oblectatus* and *C. pallidicps* (Kasangij a Kasangij 2012).

3. Termite Mounds as Key Features in the Landscape and Presenting Sometimes an Astonishing Local Typology

Two aspects will be considered.

First, in several places in tropical countries, termite mounds are key features in the landscape. This may be expressed regarding the diversity of their nomenclature, their diversity in the landscape, their diversity according to their age, and sometimes very locally, by their omnipresence in the landscape.

We have chosen an example for each of these items.

The diversity concerning the shape of termite mounds has been pointed out in numerous studies. The diverse shapes vary according to the area concerned, as well as to people involved. An example is provided below (fig. 6) from Northern Zambia and another one from Mozambique (Gilé).

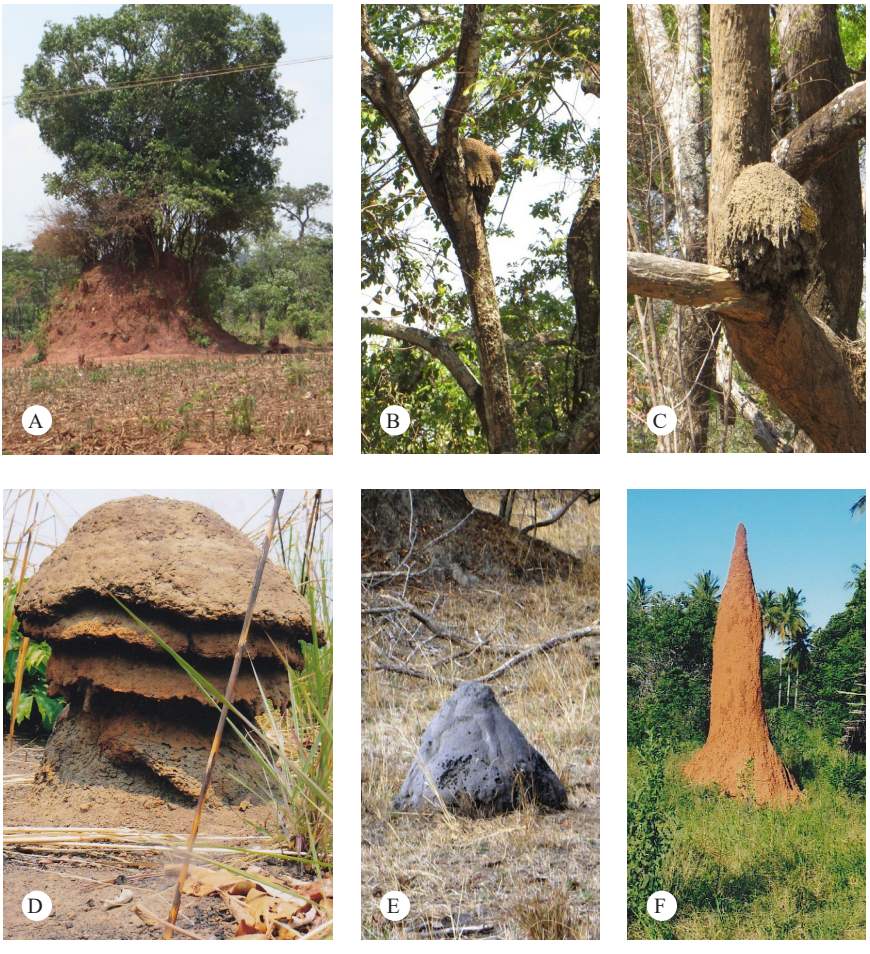


Fig. 6. — Main types of termite mounds observed in Northern Zambia (A: large conical termite mound by *Macrotermes falciger*, usually covered with more or less dense vegetation. The other termite mounds are always bare. B: aerial termite nest, suspended from a branch, built by *Macrocerotermes bequaertianus.* C: mushroom-shaped termite mound, built by *Cubitermes* sp. D: dome-shaped termite mound, built mostly in savannahs). E: small conical termite mound. One further type observed in Mozambique (F: cathedral termite mound, of red-coloured clay, built by *Macrotermes mossabicensis*). Photos A, B, C, D and E © J. Przybylowicz; photo F © F. Malaisse.

The diversity in a landscape, even in a reduced transect, may also be considered. A study carried out in Guinea-Bissau offers a good example (fig. 7).

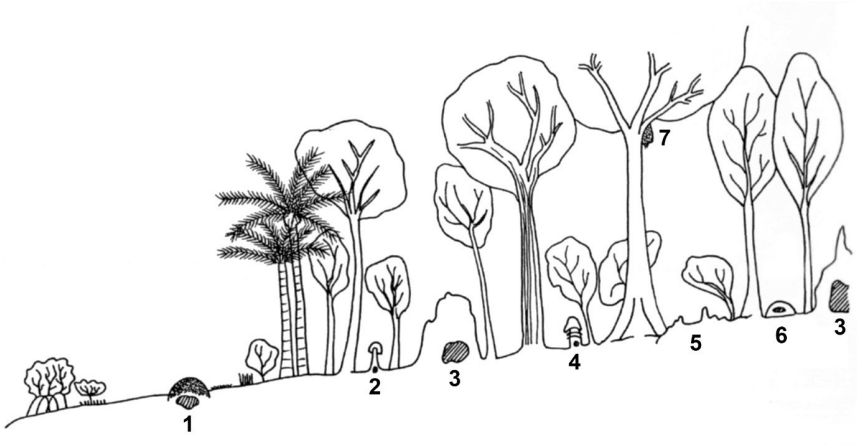
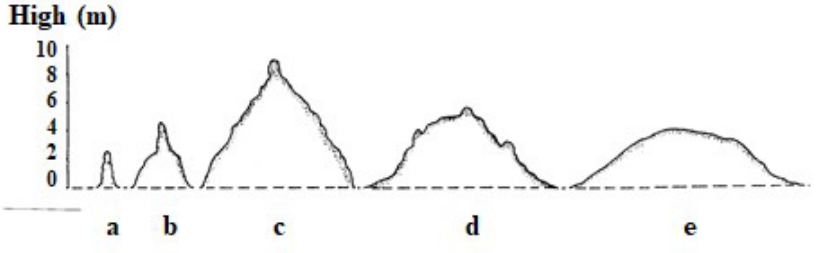


Fig. 7. — Progressing three hundred metres from the mangrove to the inland dense subhumid forest, seven kinds of termitaria may be observed, namely (1) *Trinervitermis togoensis*, (2) *Cubitermes bilobatodes*, (3) *Macrotermes bellicosus*, (4) *Cubitermes subcrenulatus*, (5) *Cubitermes severus*, (6) *Cephalotermes rectangularis* and (7) *Microcerotermes fuscotibialis* (Malaisse *et al.* 2000).

Moreover, the same kind of termite mound may be present in different shapes according to age. In Katanga, five stages may be observed in *Macrotermes falciger* mounds over a long period (fig. 8).



5 stages: a = factory chimney, b = id. surmounting a mound, c = big conical mound, d = secondary small mounds, e = hillock, like a sunked breast.

Fig. 8. — The five stages of *Macrotermes falciger* mounds (Malaisse 1997).

Finally, one photo (fig. 9) will clearly demonstrate their omnipresence in a landscape.

Fig. 9. — Termite mounds built by several species of *Trinervitermes* and *Cubitermes*. This view was taken in the Bangweulu Basin of Zambia by R. Blatrix in 2014.

The second step is aimed to illustrate the astonishing range of local typology. Once more, pictures (figs. 10, 11, 12) are worth a thousand words!

Finally, high termite mounds are sometimes called “earth cathedrals” (Girard & Lepage 1991, Verspoor & Powell 2018).

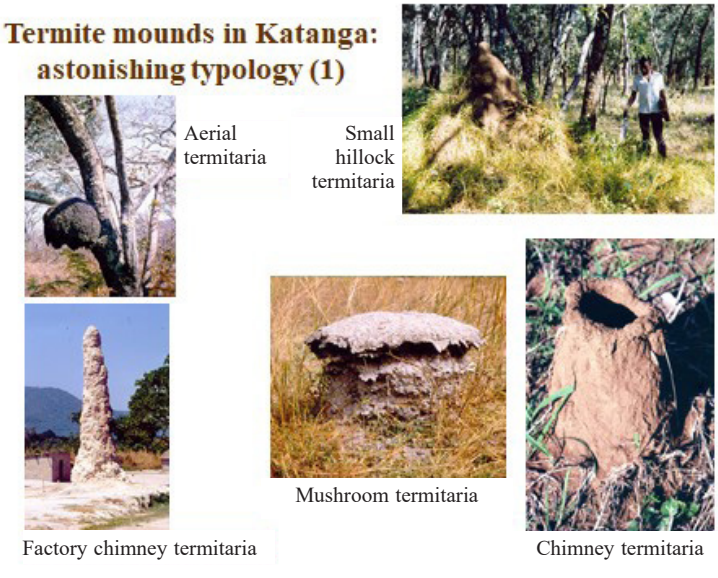


Fig. 10. — Termite mounds in Upper Katanga (1). © F. Malaisse.

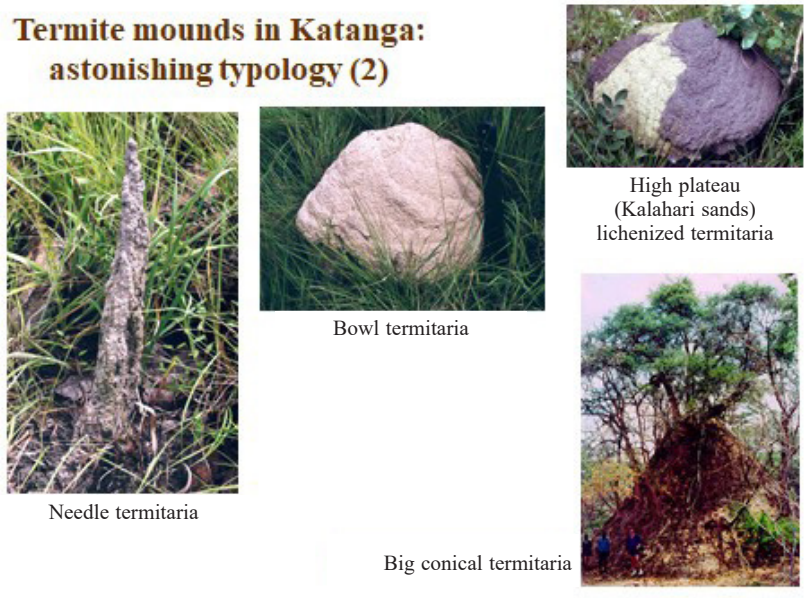


Fig. 11. — Termite mounds in Upper Katanga (2). © F. Malaisse.

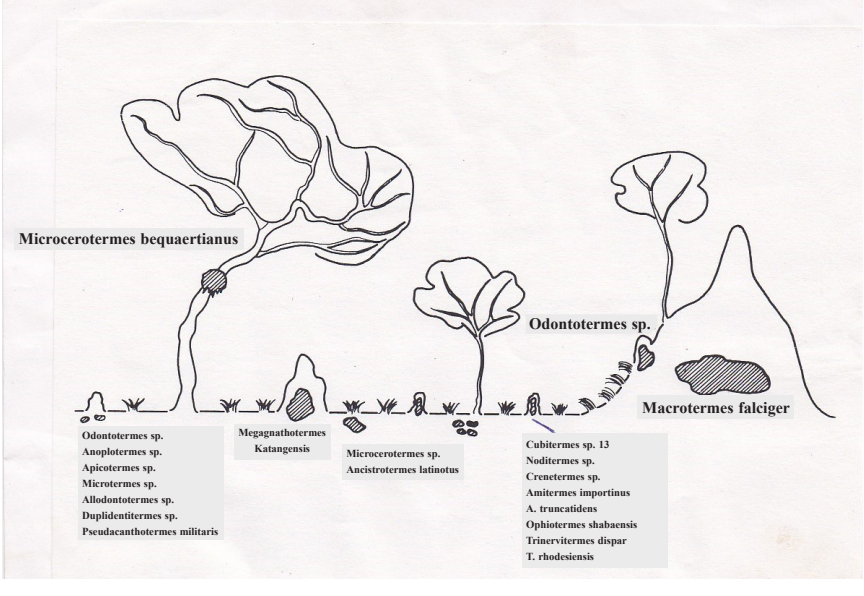


Fig. 12. — Diversity of termites and of their nests in Luiswishi open forest (Katanga) (Malaisse & Buhendwa 1982).

4. Termite Mounds as a Particular Habitat, A Well-differentiated Sub-ecosystem

Termite mounds are well-differentiated sub-ecosystems; they house particular species belonging to several kingdoms, notably fungi, plant and animal kingdoms. Just a few examples observed in the Katangan-Zambian domain have been chosen to illustrate this (fig. 13).

Fig. 13. — A high Katangan termite hill sub-ecosystem, locally called *kisukulu* (Malaisse 1978). Species represented are: 1. *Setaria lindenbergiana* (Nees) Stapf; 2. *Hibiscus ovalifolius* (Forsk.) Vahl. (habit and flower); 3. *Mylabris occidentalis* Har.; 4. *Begonia princeae* Gilg. var. *princeae*; 5. *Balanites aegyptiaca* Delile var. *quarrei* (De Wild.) G. Gilbert (a. habit, b. leaf, C. fruit); 6. *Bunaea alcinoe* Stoll (a. caterpillar, b. adult); 7. *Treron calva* (Temminck & Knip); 8. *Scadoxus multiflorus* (Martyn) Raf. subsp. *multiflorus*; 9. *Paraxerus cepapi* Smith; 10. *Euphorbia ingens* E. Mey ex Boiss. (habit, fruit); 11. *Sansevieria gracilis* N.E.Br.; 12. *Macrotermes falciger* Gerstäcker (a. adult, b. nest); 13. *Cercotrichas barbata* Hartlaub & Finsh.; 14. *Aloe greadheadii* Scholn.; 15. *Commiphora glandulosa* Schinz (a. habit, b. fruit); 16. *Crycetomys gambianus* Waterhouse; 17. *Adenia gummifera* (Harv.) Harms var. *gummifera*; 18. *Grewia flavescens* Juss.; 19. *Tapinanthus erianthus* (Sprague) Danser; 20. *Termitomyces microcarpus* (Berk. & Broome) Heim; 21. *Achatina* cf. *fulica* Bowdish; 22. *Tefflus carinatus* Klug ssp. *violaceus* Klug; 23. *Naja nigricollis* Reinhardt; 24. *Aponoma latum* (Koch); 25. *Trigona richardsi* Darchen (Malaisse 1978).

Producers are illustrated by various life forms or biological types. Phanerophytes are either ligneous (5, 15, 18), succulent (10), climbers (17) or even epiphytes (including hemiparasites, 19). Other life forms illustrated are chamaephytes (2, 14), hemicryptophytes (1), and bulbous (4, 8) and rhizomatous (11) geophytes (Colonval-Elenkov & Malaisse 1975; Malaisse 1976, 1978; Malaisse & Anastassiou-Socquet 1977, 1983). Consumers are herbivores, such as leaf-eaters (6), flower-eaters (3, 25), fruit-eaters (7, 9, 16), and even stem-hemiparasites (19), and carnivores (23). Decomposers are either animals (12) or fungi (20), each having their respective predators (13, 21), which may, in their turn, be consumed (22). Parasitism also exists on a large scale and deals with endo-parasites and ecto-parasites, such as ticks (24).

The genus *Termitomyces* R. Heim 1942 comprises thirty different species of mushrooms. They all develop on termite mounds. Ten different species belonging to the genus *Termitomyces* occur in Katanga (Heim 1977, De Kesel *et al.* 2017). They are produced from mushroom beds (figs. 14, 15).

Fig. 14. — Two views of mushroom beds and the *Termitomyces* mushrooms produced. © P. Kasangij (left) and A. De Kesel (right).

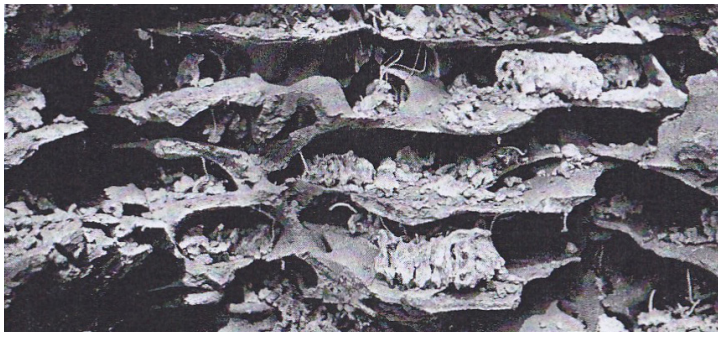


Fig. 15. — Inner view of a big *Macrotermes falciger* mound with numerous mushroom beds (Luiswishi miombo open forest). © L. Lemaire (†).

Some comments concerning two plants will be given. The first one, *Ceropegia muzingana* Malaisse (fig. 16), is only known from termite mounds located in the dry evergreen forest of Katanga. This kind of forest is locally called *muhulu* and is now very rare (Malaisse 1985, 1993; Malaisse *et al.* 2000).

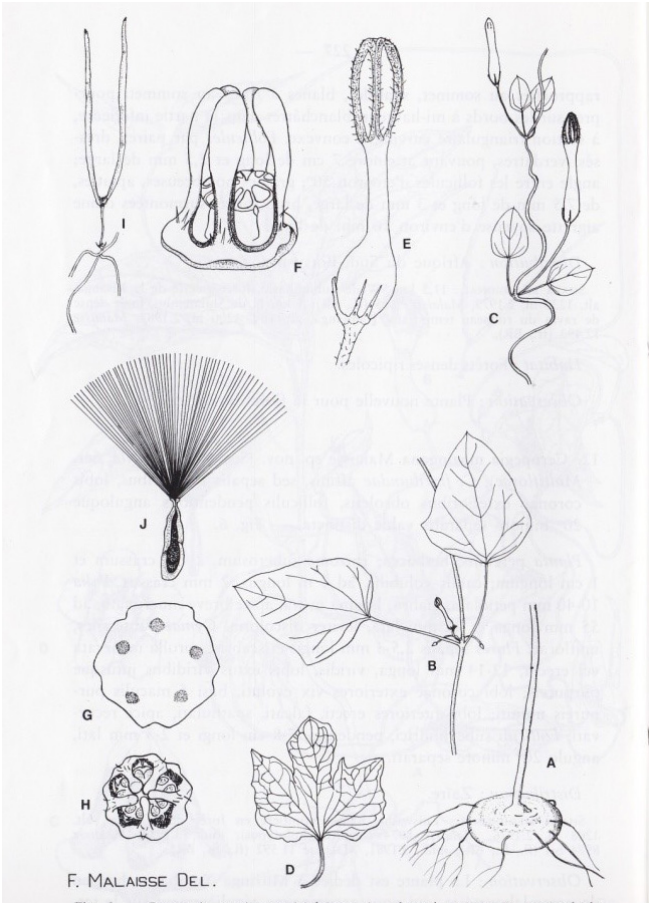


Fig. 16. — *Ceropegia muzingana* Malaisse (A. Tubercule; B. and C. Part of stem; D. Leaf; E. Flower; F. Corona; G. Corona, basal view; H. Corona, apical view; I. Fruit; J. Seed. A-C, Malaisse 8974; D-I, Malaisse 11592) (Malaisse 1984).

The second one, *Diospyros mweroensis* White, is a short semi-deciduous tree, which can grow up to 10 m high. The tree is dioecous, the female plant produces ovoid fruits. Its local name is *katula*. The tree can be found at the base and side of termite mounds located in miombo open forest. Distribution is confined to an area of 250 km by 200 km, in Katanga and neighbouring parts of Tanzania and Zambia. Poison fishing with *katula* takes place from August to September, when

the water starts to warm up, the fruits being still green and immature (fig. 17). The fruits are frequently collected one or two days before fishing. In this case, the men and women who take part in the fishing will sleep separately. A particular ceremony may take place.

As far as animals are concerned, *Trigona (Axestotrigona) richardsi* Darchen is frequently observed on large termite mounds (Parent *et al.* 1978). This social bee belongs to the Apidae family, Meliponini tribe (see fig. 13, no. 25).

Fig. 17. — Immature green fruits of *Diospyros mweroensis* White. © F. Malaisse.

5. Termitophagy, a Surprising World to Discover

At least thirty-two species of termites, that is to say 1.03 % of the world diversity, are eaten by man. They belong to seven families, Macrotermitidae (thirteen species) are dominant in Africa, Nasutitermitidae in South America. Termites are consumed in South America (Colombia, Venezuela, Guyana and Brazil), in Asia (India, Nyanmar, Vietnam, Thailand, Philippines and Malaysia), in Oceania (Indonesia, Australia) and in Africa (see below).

The consumption of termites in Africa has been covered in more than two hundred and seventy-five papers and books (fig. 18). The oldest reference known for Africa was given by Labat (1732, p. 183) who reported that, according to Cavazzi, alate termites are regarded as delicacies by the populations of Congo and Angolle: “What a treat to have them roasted!”. Relevant comments on termitophagy were first published in travel stories of early explorers, notably Smeathmann (1781), Monteiro (1875), Pogge (1880), Serpa Pinto (1881), Baumann (1887), Drummond (1888) and Stuhlmann (1894).

Some exhaustive studies deal with ethnological and ecological aspects, including termitophagy. Among those are, for example, the ethnological studies of Hegh (1922), Iroko (1996) and Dounias (2016), ethnological studies devoted to the Aka (Bahuchet 1985), the Gbaya (Roulon-Doko 1992, 1998), or the Bemba (Malaisse 1997, 2010), ethnozoological approach of the Yansi (Tango Muyay 1981), the Ngangela and the Nkoya (Silow 1983), as well as a study devoted to termite consumption in Burkina Faso (Ouédraogo 2005). Moreover, more and more papers on termitophagy are published per decade.

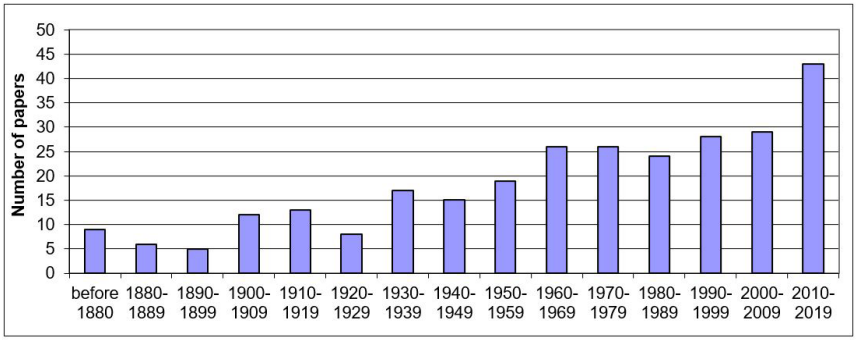


Fig. 18. — Number of publications with comments about termitophagy in Africa.

At least eighteen different species belonging to two families and four subfamilies are consumed in Africa (Malaisse 2010, p. 247). The number of the different ethnospecies of termites eaten varies according to the ethnolinguistic groups concerned. The highest values concern the Gbaya (13 spp.; Joulian & Roulon-Doko 1994), the Tikar (12 spp.; Clément 1996) and the Zande (8 spp.; de Schlippé 1956).

A global synthesis indicates that nine items may be consumed (fig. 19).

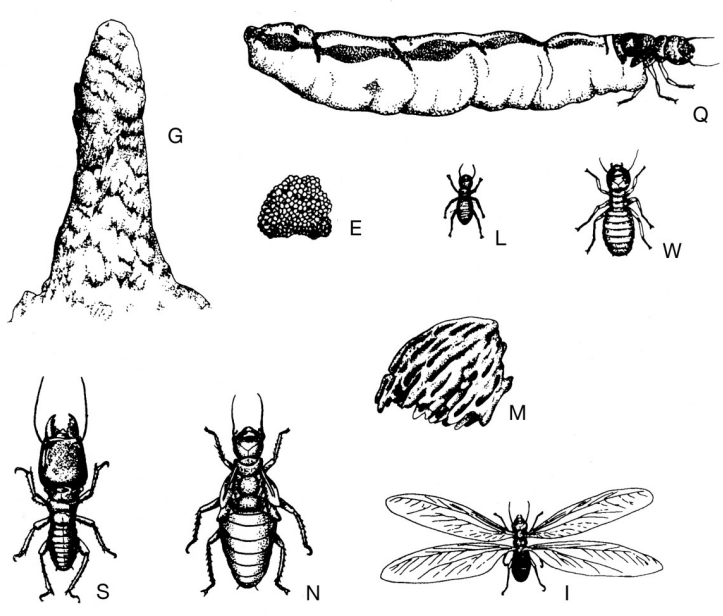


Fig. 19. — Diversity of items in termitophagy (E = eggs; G = geophagy; I = imago; L = larva; M = mushroom bed; N = nymph; Q = queen; S = soldier; W = worker) (Malaisse 2010).

From a study of two hundred and fifty different ethnolinguistic groups, the respective importance in decreasing order of the nine items is: imago (two hundred and twenty-six groups, 90.4 %), queen (sixty-four groups, 25.6 %), soldier (twenty-five groups, 10.0 %), nymph (thirteen groups, 5.2 %), mushroom bed (five groups, 2 %), geophagy (six groups, 2.4 %), eggs (three groups, 1.2 %). The consumption of larvae and workers was not taken into consideration, whilst the use of oil obtained from adults and used for cooking (soup or sauce) was quoted by six groups or 2.4 %.

Finally, a pink-coloured map of Africa showing the ethnolinguistic groups practising termitophagy was published some years ago (Malaisse 2005).

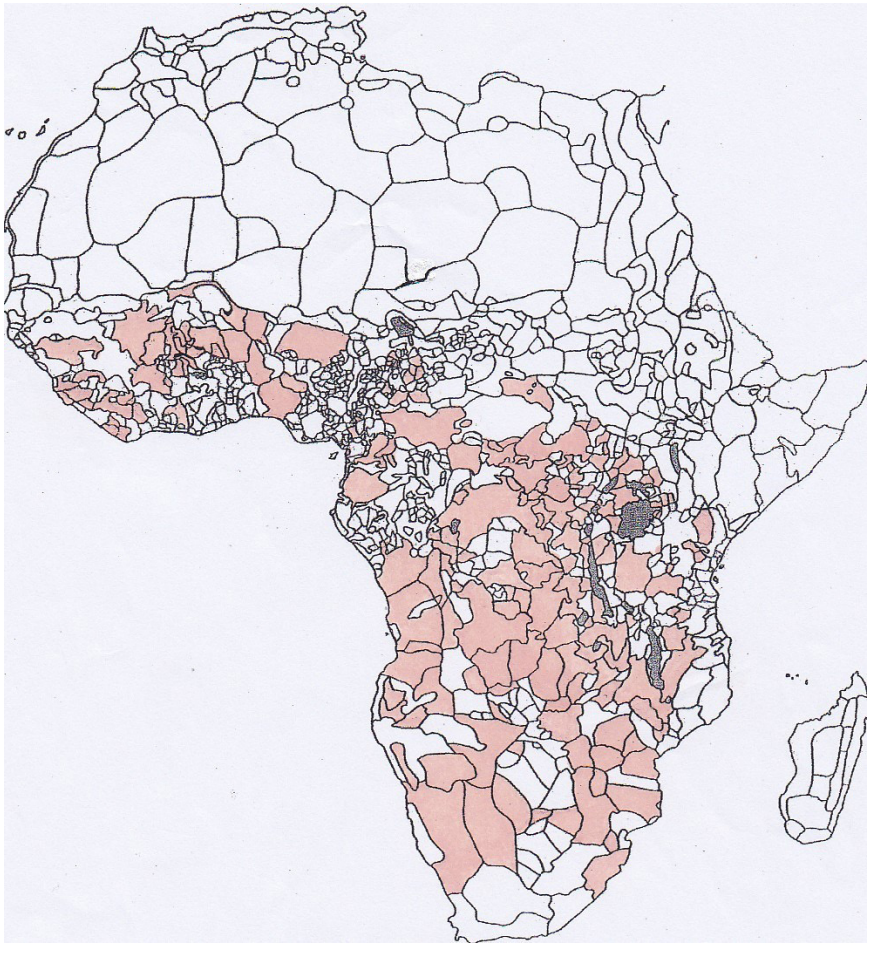


Fig. 20. — Areas of Africa concerned with termitophagy. Each area deals with one ethnolinguistic group (an inventory of one thousand twenty ethnolinguistic groups has been made for Africa).

6. Termites, as Makers of Towns and Other Uses of Termite Mounds

6.1. Termite Mounds for House Building

In South-Eastern Katanga and Northern Zambia, termite mound soil has been and is still used to make bricks (Aloni *et al.* 1981, 1993). The high termite mound is cut open with a hoe following a vertical crack. The peripheric layer, which includes tree roots and shrub roots, is not used. Also the highly-carbonated zones where calcareous concretions and nodules can be observed are discarded. The remaining loosened soil is compressed with hand-operated presses to produce standard-size bricks. The bricks are air-dried, stacked, then fired with wood from the neighbouring open forest (figs. 21, 22, 23).

The average production is two hundred seventy-one thousand bricks per termite mound. Baked bricks have long been the main material used in house construction. A simple 50 m^2 house with four rooms requires some thirty thousand bricks. On the basis of this reasoning we could assess in 1985 the number of bricks (15.10^8) necessary to build the houses of Lubumbashi, a town that spanned 3,160 ha and totalled six hundred thousand inhabitants. A simple calculation shows that a density of two termite mounds per hectare is enough to produce the amount of bricks needed. However, the city was founded on a site that contained three to four termite mounds per hectare. By using a similar calculation we came to the conclusion that the towns created in this region (Lubumbashi, Likasi, Kolwezi, Ndola, Kitwe, among others) with a population varying from one hundred twenty-five thousand to seven hundred thousand people were built with the pre-existing termite mound soil!

After this period the construction of buildings started off in the central part of the towns and the former process became restricted to peripheric urban areas (Malaisse 2018).

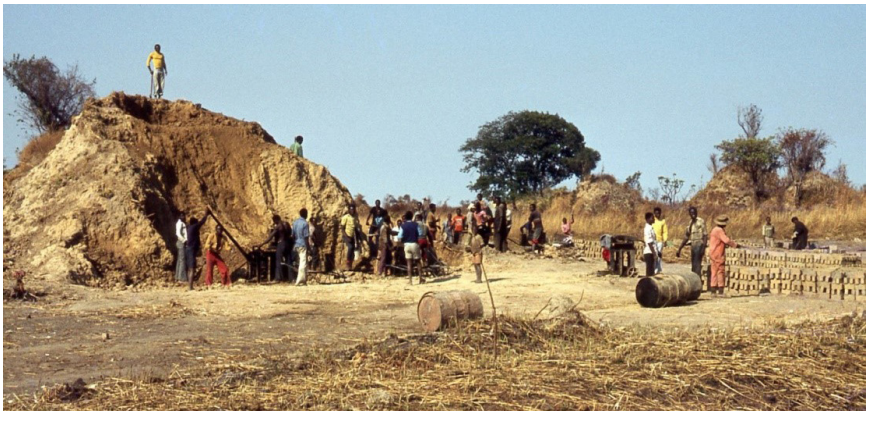


Fig. 21. — The termite mound located on the left furnishes the bricks. © L. Lemaire (†).

Fig. 22. — Great activity at the foot of the mound. © F. Malaisse.

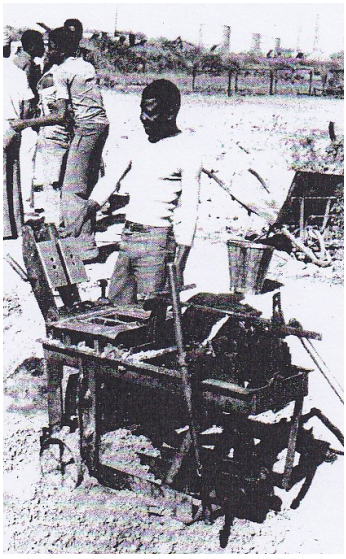


Fig. 23. — The hand-operated brick press. © F. Malaisse.

6.2. Use of Termite Mound Soil for Cereal Crop Stores and Coating of Surfaces

Other uses of the soil of termite mounds have still to be mentioned. This is notably the case for the construction of cereal crop stores by the Mofu of Northern Cameroon (fig. 24), as well as plastering wall surfaces by the Mossi of the central shelf of Burkina Faso (Dezwaene 2004).

Fig. 24. — Cereal lofts constructed by the Mofu of Northern Cameroon. © F. Malaisse.

6.3. Termite Mound Soil Used for Native Copper Smelting Furnaces

Different uses of termite mound soil have been reported. Verbeken & Walraet (1953) published a nice photo of a native copper smelting furnace used for smelting malachite for making copper castings and crosses. We had the chance of discovering remains of such a furnace on the slope of a termite mound (fig. 25).

Fig. 25. — Remains of two copper smelting furnaces on the slope of a termite mound in the area of Kwatebala. © F. Malaisse.

6.4. Termite Mound Soil for Making House Walls

At Mâh, near the Lésio-Louna Reserve, 100 km north of Brazzaville, in two typical Batéké Plateau ecosystems, namely *Parinari excelsa* Sabine and *Piptadeniastrum africanum* (Hook.f.) Brenan evergreen forests and savannahs dominated by *Hyparrhenia diplandra* (Heck.) Stapf and *Hymenocardia acida* Tul., termite mound soil is used. Lumps of black termitaria, locally named *Ikou* and found in savannahs, are cut out in rough bricks and built into a wall. These are kept upright with branches tied together. This relatively fragile wall is then coated with clay-like soil from yellow termite mounds, called *Ichion*, found in evergreen forests; this yellow soil has been used to make traditional house walls (Miabangana, pers. comm.) (figs. 26, 27, 28).

Fig. 26. — Fragments of *Ikou* mound. © E. Miabangana.

Fig. 27. — *Ichion* termite mound. © E. Miabangana.

Fig. 28. — Traditional termite house.
© E. Miabangana.

7. Cultural Aspects

All studies carried out on local in-depth knowledge of termites and termite mounds have provided a lot of data on cultural aspects. These studies show an astonishing richness both concerning the large range of subjects and the sheer abundance of data. Iroko's (1996) book, "L'homme et les termitières en Afrique", seems to us the best example of cultural aspects. Here are a few examples to illustrate the wide range of themes.

7.1. Distinction and Recognition of Termites and Termite Mounds

The distinction and recognition of termites and termite mounds by the local population requires knowledge of termites' biology (season and hours of swarming), size and pigmentation of alate adults (from light auburn to pure black) or of soldiers' heads (dark red to black), aspects of termite mounds, and the associated mushroom aspects. For instance, in Zande country, for four edible species, the swarming hours are: 18-20 h (*Ali*), 21-22 h (*Anvutu*), 4-6 h (*Atumbu*), and in full daylight (*Asuo*) (De Smet & Huysecom-Wolter 1972).

The richness of the local classification of termites in *mòoré* language has been underlined by Dezwaene (2004).

7.2. Trapping Methods of Termites

The range of harvesting techniques used for the different states of termites varies greatly according to the various ethnolinguistic groups.

Flying termites are caught when going on their wedding flight. Figure 29 illustrates some of the techniques used regarding the alate imago. They include collecting the imago on the soil, hand catching at twilight with a basket, extracting the larvae, workers, nymphs and alates from the base of the mound, covering of mounds or using a night torch.

Fig. 29. — Catching techniques used for alate termites (upper line, from left to right: manual picking and catching when flying by the Bakongo in Bas-Congo, opening of termite mound by the Fon in the vicinity of the Nimba Mounts in Benin); (lower line, from left to right: covering-up of termite mounds on Bateke plateau in Gabon, light trapping near Nazinga by the southern Bobo Madaré in Burkina Faso). Upper line: © W. Bassa Dheu & S. Tshibozo. Lower line: © R. N. Poligui & M. Ouédraogo.

The trapping of alate termites by a light source has been quoted frequently. For instance, a large bowl of water near the light source is used by at least eight ethnic groups in Burkina Faso (Séré *et al.* 2018). The construction of a light trap harvester and its yield has been tested in the Lake Victoria region for mass collection of *Macrotermes subhyalinus*. Its use has been recommended (Ayieko *et al.* 2011).

In some places a trench is dug on the slope of the termite hill in such a way that the mouth of the nest is at the highest point. A wide-mouthed earthern pot, filled with water, is placed at the lower end of the trench.

To collect the soldiers, the mouth of the nest is opened out. Long blades of grass or split-reeds are pushed down the channel and then withdrawn. The soldiers stick their large mandibles into the grass. The grass is withdrawn and the termites are shaken into a collecting vessel. This technique is also used by some chimpanzees (Joulian & Roulon-Doko 1994).

Finally, there are certain requirements, described by Tango Muyay (1981) for the Yansi, when collecting nymphs as they turn into imagoes in the large termite mounds. Women must neither have sex the day before collecting, nor obviously be pregnant. Young girls are also excluded because their sexual activities may not be known.

7.3. Consumption Processing

Termites are usually directly dried in the sun or lightly fried in their own fat. Less frequently they are grilled, smoked or dried after boiling. Consumption of raw termites is rare, but can happen. Termites are also squeezed to obtain cooking oil, which is used locally to prepare soup or sauce. Finally, they may be dried and reduced to powder, which is poured into water and boiled.

7.4. Alate Termites as Easy Prey for Birds

Alate termites are very efficient to attract birds. In several parts of Africa they are used in this way. We have chosen one example from Lower Kongo, another one from Upper Katanga.

In Lower Congo, when birds migrate to the south, the Kongo people put plenty of lime from *Voacanga africana* Stapf ex Scott-Elliot fruits on the petioles of palm trees, which are then put on the ground. Then, a small *Cubitermes* mound is opened and immediately alate termites take their flight. Birds try to catch them, but frequently first land on the ground. Some get stuck in the lime and villagers catch them (Aloni, pers. comm.; Latham & Konda ku Mbuta 2014).

In Upper Katanga, a trident with alate termites is used by Bemba population. The axes of the trident are full of lime and birds are trapped by the lime when trying to eat the termites (fig. 30).

Fig. 30. — Trident with lime and alate termites. © F. Malaisse.

7.5. Villagers or Village Chief as Owners of Termite Mounds and/or Queens

In several ethnolinguistic groups, there is a permanent right of ownership on the termite mounds; they are either the property of a village or of a family. As a result, people are warned: “Do not touch my termite mound!”. For instance, collecting mushrooms on termite mounds is frequently a social activity (figs. 31, 32). Such ownership has, for instance, been quoted for the Zande (de Schlippé 1956). In different groups, the queen may only be eaten by the village chief. This is notably the case for the Bangala in the vicinity of Mobwasa.

7.6. The Place of Termite Mounds in Myths

Fig. 31. — Villagers collecting mushrooms. © L. Lemaire (†).

The origin of the world myth among the Dogon of Mali Republic is a good example. It is as follows: the stars are lumps of soil thrown into the universe by God, Amma. That was the beginning of the earth, "a pudding of clay"; in fact, it was a woman who had an ants' nest as a sex symbol and a termite mound as a clitoris. God wanted to unite with this creature, but, just before acting out, the termite mound stands up, providing its ambiguity and its partial masculinity in this way and prohibiting access. This setback irritated God, who cut down the termite mound and came together with the excised earth (Iroko 1996). Though the excision of the clitoris is still frequently practised locally, there is no connection with this myth.

Fig. 32. — Plenty of mushrooms on termite mounds. © F. Malaisse.

7.7. The Importance of Termite Mounds' Mushrooms in Myths

Oso (1976) commented in detail on the importance of termite mounds for mushrooms in Yoruba mythology. The Yoruba are a people of southwestern Nigeria. The Yoruba name for God is *Olodumare*. Regarding omniscience and wis-

dom, *Olodumare* has a deputy on earth known as *Orunmila*. Oral traditions emphasize the part played by *Orunmila* in guiding the destinies, both of divinities and men. The Yoruba consult *Orunmila* when they want to avert unhappy issues, and need to know what they should do to get certain things urgently, etc. *Orunmila* communicates with its messenger *Ifa*, the god of divination, and also with men. Diverse *Termitomyces* species have their own name in Yoruba (*T. microcarpus* = *Olu-Oran*, *T. robustus* = *Ewe* and *Ogogo*). An example given by Oso (1976) is the case, in a distant past, of a man, *Ogogo*, who had bad luck, and who never succeeded in anything he put his hand to. *Orunmila* examined his destiny and told him which sacrifice he would have to make. He led *Ogogo* to tree *Annona senegalensis* Pers. There, with an unused sponge, some African black soap and the infusion obtained after sacrificing a pigeon, he washed *Ogogo*'s head seven times at seven different spots round the tree. On their way back home *Orunmila* informed *Ogogo* that after nine days they would pay another visit to the tree to detect any special sign that could be taken as an omen to cleanse him from his bad luck. On visiting the tree on the ninth day they discovered mushrooms growing in large numbers from the seven spots where the washing had taken place. The mushrooms, called *ogogo,* were eaten, considered as delicious and a great demand for this mushroom persists today.

7.8. Termites of Ill Omen

Seignobos *et al.* (1996), in a study devoted to the Mofu and their insects, pointed out that termites are of ill omen. The termite *majara* has negative connotations. Pregnant women do not step over their termite mounds, in which snakes that have been killed are buried, for fear of getting sick.

Moreover, *dliba* termites may sometimes ravage a millet loft. For the Mofu the cause is easy to establish: "it is due to the evil spell put on it by the maternal uncles". The only remedy consists in offering a sacrifice and by sending them beer and goats as a gift.

Finally, adults ask children to move away from a *ndakkol* termite mound. If they damage the mound, even unintentionally, the consequences would be that they would meet a bad spirit or be drowned during the next rainy season.

7.9. Oracle Pronounced by the Termites or *Dakpa* among the Azande

This is an oracle open to everyone, mostly the poor Azande, a population of the eastern Central African Republic, southwest of Sudan and northeast of D. R. Congo. Our information concerning this oracle is provided by Evans-Pritchard (1937).

This oracle involves no expense, as one has only to find a termite mound and insert two sticks taken from two different plants (namely *Bauhinia reticulata* or *dakpa* and *Hibiscus esculentus* or *mboyo*) into the tunnels and to return the next

Fig. 33. — Termite-eaten stick (far right). When the consultation is finished, the sticks are rolled up in a leaf (left), and these are brought back home (Evans-Pritchard 1937).

day to see which sticks have been eaten (fig. 33). The response depends on the way in which the question is asked. This oracle takes time as the whole night is required to obtain a response to one question.

The most frequently consulted termites are the *akedo* and the *angbalimondo*; moreover, the *abio* termites frequently lie! The place where the two sticks are inserted into the mound varies with the termite species concerned.

7.10. Denomination of Some Periods of the Year

Termites have been for a long time used by some ethnolinguistic groups to denominate certain periods of the year. For instance, in Upper Katanga, some people speak of "the month of the appearance of flying termites" as reported by Centner (1963) in a study concerning Elisabethville (now Lubumbashi).

8. Termites and Termite Mounds are Source of Wisdom

We decided, several years ago, to produce a collective book devoted to proverbs, maxims, tales, stories, songs, riddles, etc. dealing with termites and termite mounds in Africa.

As explained in the introduction, termites are social animals and comparisons with our social life are frequent. These proverbs suggest what to do, or to avoid, in different situations and thus frequently guide us in the actions we take.

According to ethnologists, one thousand twenty distinct linguistic groups are to be found in Africa. We decided to try to put together as many proverbs as possible, involving the greatest number of ethnolinguistic groups. We invited a lot of people and informed each person participating in this effort that he or she would be a co-author.

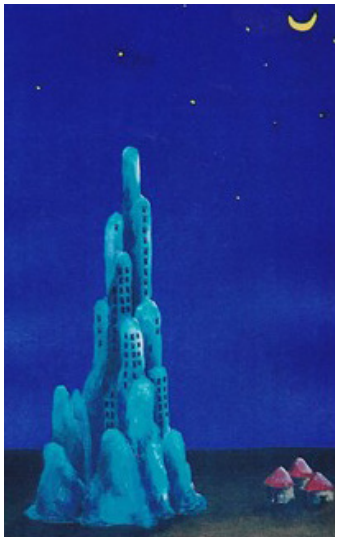
We suggested that there should be one proverb per page, with a particular presentation. Data requested were: (1) the language used, (2) the source of information. For the latter there are several possibilities. If the proverb had already been published, the author and references had to be given. If the proverb had not been published, we requested the name of the informant as well as the name of our collaborator who had been able to collect the information.

The proverb is presented in four steps. First, it is given in the local language (where possible a phonetic orthography is used). Secondly, a literal translation, word by word, is given in French or English. Thirdly, a literal sentence is provided. Lastly, comments are made, for instance to explain in which situation the proverb is expressed or why the proverb is used.

Each time, we tried to select a photo or a drawing to illustrate the sentence. Currently we have two hundred and seven proverbs coming from ninety ethnolinguistic groups located in sixty-two countries.

For the present paper, four proverbs have been selected as good examples.

— Example 1: a Mòoré proverb, written in French by Bonnet (1982, p. 107):



As high as a termite mound could be, it never will reach the moon (fig. 34).

A first comment is: “The termite mounds are far from the moon … and will remain so! In spite of the tremendous size of some of them, they do not bring the termites nearer to the moon”.

The enigma is: “we must be able to moderate, to restrain our desires and our ambitions, let us remain humble”.

The proverb is used for example: if a child returning home asks for a bicycle like one of his or her friends, your response is this proverb.

Fig. 34. — Illustration proposed for proverb 1. © C. Van Marsenille.

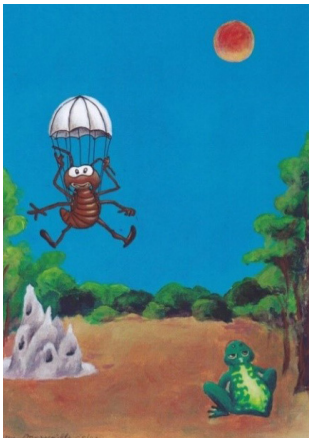
— Example 2: a Cokwe [Angola] proverb, provided by Z. Sakawanga & N. Dikumbwa (unpublished):

- Wording: *kenene*/*zondola*/*kaswa*.
- Literal translation: soldiers/to inform/ alate termites. Meaning: the soldiers inform the alate termites.
- Comment: before the alate termites leave the termite mound, the soldiers go

out to check the conditions (fig. 35). They particularly check that it is not too dark and that no one walks around. If all is well, they return into the mound and tell the winged termites that they are free to go out.

Fig. 35. — Illustration proposed for proverb 2. © M. Schaijes (†).

— Example 3: a Bemba proverb (in Lomotua dialect), provided by K. E. Kisimba (†) and S.Cabala (unpublished):



Wording: *kyula /kudja /nswa/ayo/ine/ileta*.

Literal translation: toad/to eat/termite(s)/that/who/coming to.

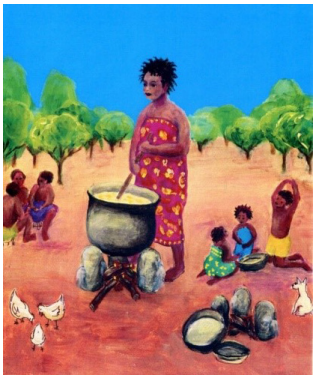
Meaning: the toad eats the termites coming to it (fig. 36).

Comments: this proverb is expressed to clarify. In fact, “I do not tempt anyone, it’s them who tempt me!”

An analogue proverb has been quoted for the Igbo people of Nigeria, namely: “after flying the termite will fall to be eaten by the toad”.

Fig. 36. — Illustration proposed for proverb 3. © C. Van Marsenille.

— Example 4: kongo proverb, provided by K. J. Aloni (unpublished):



Wording: *makuku ma tatu ma telalamasa kinzu vahy*.

Literal translation: “small termite mound/they/three /they/keep stand/cooking-pot/on fire”.

Meaning: only three small termite mounds are able to keep a cooking-pot standing on fire (fig. 37).

Comments: given as a reproach, this proverb is devoted to people who neglect team solidarity. It reminds us that alone we are weak. There is some similarity with the French “L’Union fait la Force”.

Fig. 37. — Illustration proposed for proverb 4. © C. Van Marsenille.

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