Bull. Séanc. Acad. R. Sci. Outre-Mer

Medel. Zit. K. Acad. Overseese Wet.

6x (2018 – x) : xxx-yyy

Termites and termites 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 is also dealt with ; (6) the importance of termite in building towns and for other uses of termite mounds ; (7) the diverse cultural perception of termites is also considered, 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 200 proverbs recorded in more than sixty different languages.

MOTS-CLES. --- Termites ; termitières ; typologie ; Afrique ; termitophagie.

RESUME. --- 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 paysages et présentant une typologie locale étonnante ; (4) les termitières comme un habitat particulier, un sous-écosystème bien différentié, hébergeant quelques espèces relevant de divers règnes et à distribution limitée à cet habitat ; (5) la diversité de la termitophagie est également abordée ; (6) l'importance des termites comme constructeurs de villes et autres usages des termitières ; (7) les diverses perceptions culturelles des termites sont aussi considérées, leur place dans les religions, mythes, leur usage médicinal, les techniques de captures. Enfin, last but not least,

(8) termites et termitières comme sources de sagesse, comme indiqué dans plus de 200 proverbes relevant de plus de 60 langues différentes.

* Paper presented at the meeting of the Section of Natural and medical Sciences held on 28 May 2018. Text received on 15 October 2018 and submitted to peer review. Final version approved by the reviewers on xx Bbbbb 2019.

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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 12 families (Myles 1998). Recently, they became a Suborder, namely the Isopteroidea of the Blattoptera Order. Today it is suggested that they belong to the Epi-family of Termitoidea. Some 3,106 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) 5 of the 7 families, 112 of the 280 genera and 669 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 imagos (or reproductives). Reproductives (queen and king), after a short nuptial flight, will lose their wings and found a new colony, the queen producing eggs.

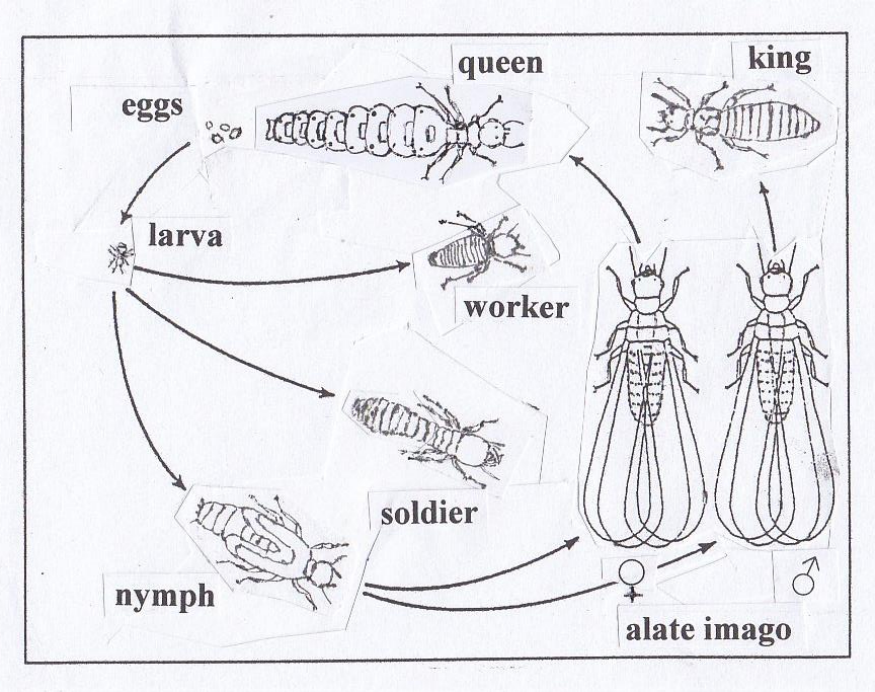


Fig.1.- Termite cycle

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, on the number of segments on the tarsus (4, 4-5 or 5) 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 recognized, 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.

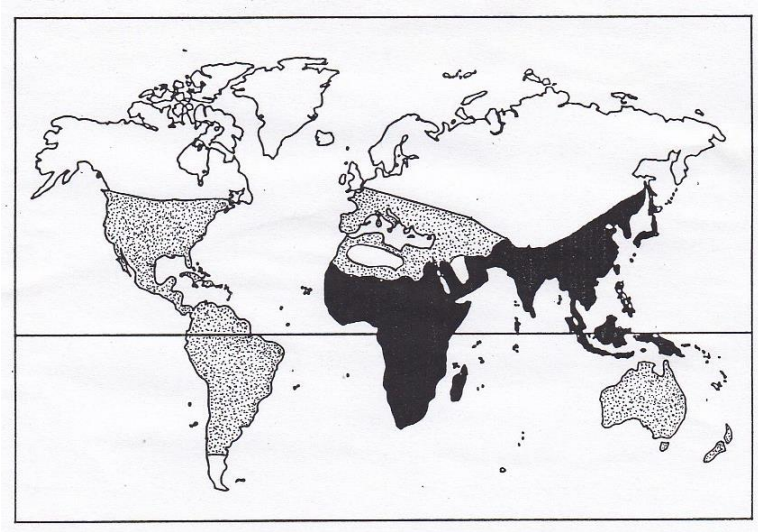


Fig. 2.- Distribution of the Termitoidae (grey : total area, black : Macrotermitidae)

For basic knowledge we suggest the book « Termites: Evolution, Sociability, Symbioses, 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 Central and South America, South-East Asia and Oceania, as well as for Western Africa and Ethiopia. Regarding these, the papers published by A.G. Banderia and C. Martius for the Amazon, by G. Josens, M. Lepage and T.G. Wood for Western Africa, by T. Abe for Western Malaysia, by N.M. Collins for Sarawak and by N. Lo for Australia are recommended.

Nevertheless, it appears that information and data concerning South-Central Africa, an area relevant to the Zambezian domain (White 1983), have frequently not be taken into account.

For instance, in a list of 63 sites given by Bignell & Eggleton (2000) no mention is made of the Zambezian open forest. Eggleton (2000) points out that the literature on termite distribution patterns in Africa is large, but not comprehensive. None of the six papers quoted by him concerns South-Central Africa.

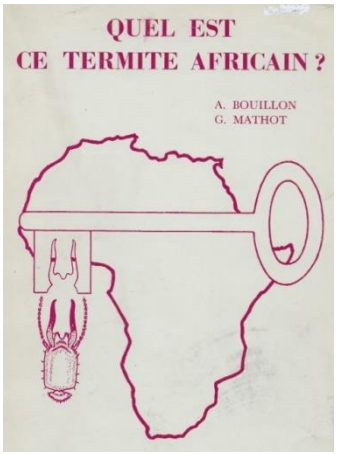


Fig. 3.- Cover of Bouillon & Mathot book.

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) provide us with all the information required to identify to species level. More over this information is supported by 25 clear plates. .

Finally, regarding Africa, the first book on the biology of termites had already been published in 1781, with H. Smeathmann.

Fig. 4.- Some account 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). They 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, however 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.

Below, some comments are given 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 is increasing, the total energy of the colony decreases continuously until about 130 days, when the total population is about 100 individuals (data for *Macrotermes michaelseni* after Lepage & Darlington, 2000). After about 300 days, with a population of 250-300 steriles, the total energy of the colony has regained its initial value. At this state, 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 $\pm$ three meters height are quoted within three years from first appearance.

Two other studies concerning the same genus will confirm the wide range of issues dealt with. Girard & Lepage (1991) report that the nest of *Macrotermes bellicosus* is at first hypogeous. During the two first 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 3 to 6 meters 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 1,500 termitophilous species have been identified in colonies. The adult colony may be destroyed by specialized predators, of which Dorylines 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 build by *Macrotermes falciger*, the study carried out by Erens et al. (2015a) presents a totally different approach and also arrives at 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, 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 to analyse in detail the effects of each group is not possible in this paper. However, as an example, we choose the soil feeding termites. A review of the knowledge concerning them has been 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 tunnelling networks. Trophallaxis is also reported. The latter 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. The 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 agent 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 electro-chemical 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 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 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 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). On the right a view taken at one km of Luano airport (Lubumbashi) in 1972 by F. Malaisse. Values of 5.6 mounds per hectare, 5.1 m mean height and 31.0 m^2 mean basal area where measured in the field.

Fig. 5.- Aerial view of termite mounds

A recent study (Mujinya et al. 2014) provides 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).

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 that they are 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 1.460 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 where 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.

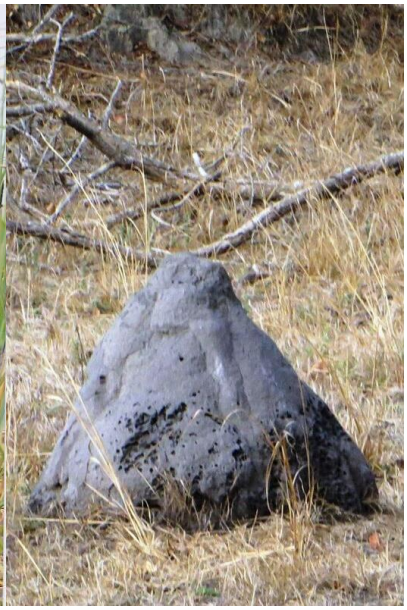
First, in several places in tropical countries, termite mounds are key features in the landscape. This may be expressed regarding the diversity of their nomenclature, their diversity in the landscape, their diversity according to their age, and sometimes very locally, by their omni-presence in the landscape.

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 from Northern Zambia and one from Mozambique (Gilé).

A.- Large conical termitaria built by *Macrotermes falciger* bearing a dense vegetal cover.

B.- Aerial termite mound built by *Macrocerotermes bequaertianus*.



C.- Mushroom shaped termite mound. .

D. Dome shaped termite mound.

E. Cathedral termite mound

Photos A, B, C and D © Jolanta PRZYBYŁ0WICZ ; Photo E © François MALAISSE

Fig. 6.- The main types of termite mounds observed in Northern Zambia. A: Large conical termite mound (constructed by *Macrotermes falciger*) usually covered with more or less dense vegetation. The other termites mounds are always bare.- B: Aerial termite nest,

suspended from a branch.- C: Mushroom shaped termite mound, built by *Cubitermes* sp..- D: Dome shaped termite mound, built mostly in savannahs. One further type observed in Mozambique - E: Cathedral termite mound, of red coloured clay (built by *Macrotermes mossabicensis*).

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.

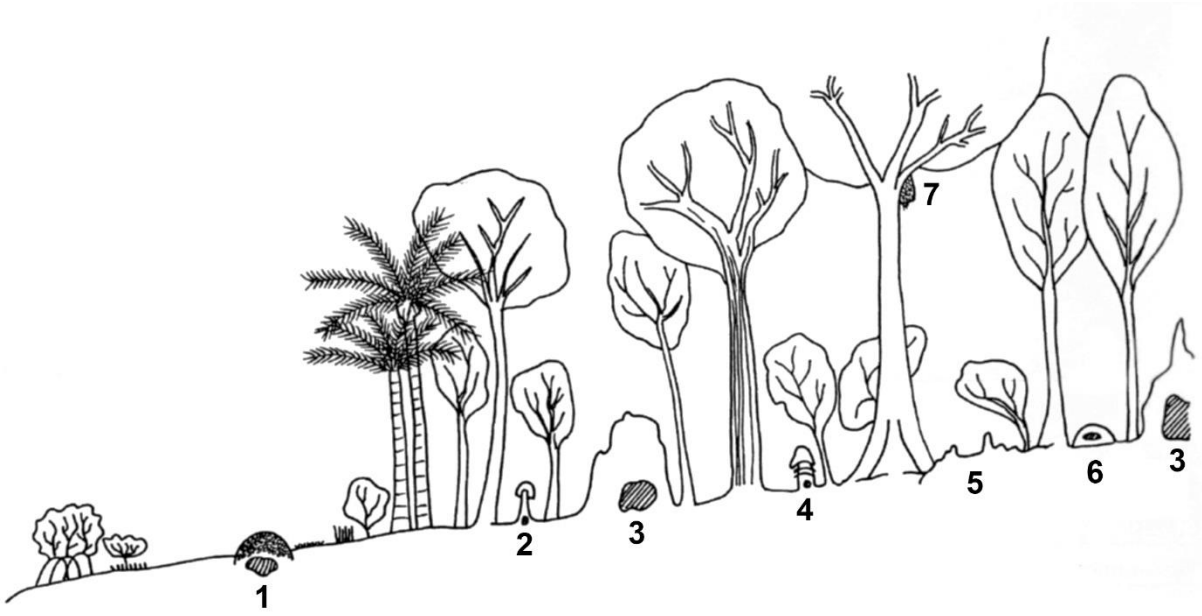


Fig. 7.- Progressing three hundred meters from the mangrove to the inland dense subhumid forest, seven kinds of termitaria may be observed, namely (1) *Trinervitermis togoensis*, (2) *Cubitermes bilobatodes*, (3) *Macrotermes bellicosus*, (4) *Cubitermes subcrenulatus*, (5) *Cubitermes severus*, (6)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

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

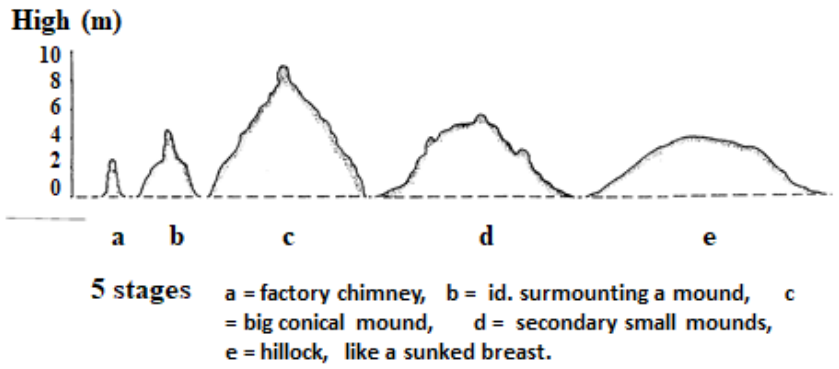


Fig. 8.- The five stages of *Macrotermes falciger* mounds (Malaisse, 1997).

Finally, one photo will clearly demonstrate their omni-presence in a landscape.

Fig. 9.- These termite mounds are 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 are worth a thousand words !

Fig. 10.- Termite mounds in Upper Katanga

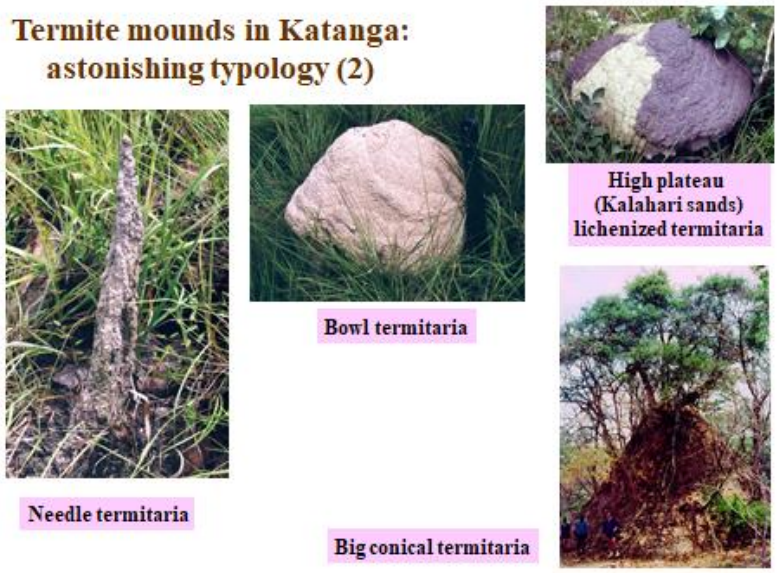


Fig. 11.- Termite mounds in Upper Katanga

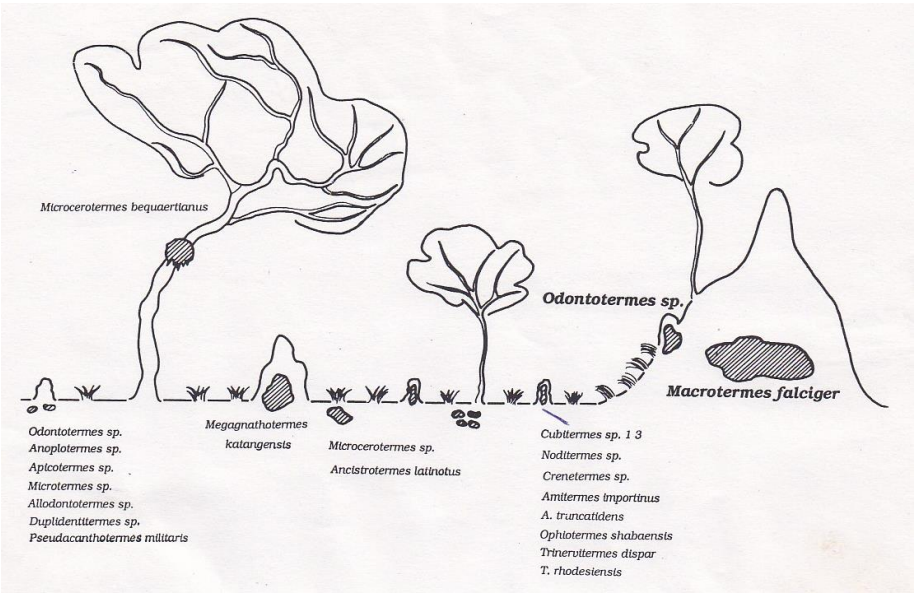


Fig. 12.- Diversity of termites and of their nests in Luiswishi open forest (Katanga) (Malaisse, 1997).

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

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

comments concerning some examples observed in the Katangan-Zambian domain have been chosen to illustrate this.

Fig. 13. A high Katanga 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. & br.) 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.

Producers are illustrated by various life forms or biological types. Phanerophytes are either ligneous (5, 15, 18), succulent (10), climber (17) or even epiphytes (including hemiparasites,

19). Other life forms illustrated are the chamaephytes (2, 14), the hemicryptophytes (1), and bulbous (4, 8) and rhizomatous (11) geophytes (Colonval & 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 possessing 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 30 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 mushrooms beds.

Fig. 14 and 15.- Two views of mushroom beds and the *Termitomyces* mushrooms produced. © Patrick KASANGIJ (left) and André DE KESEL (right).

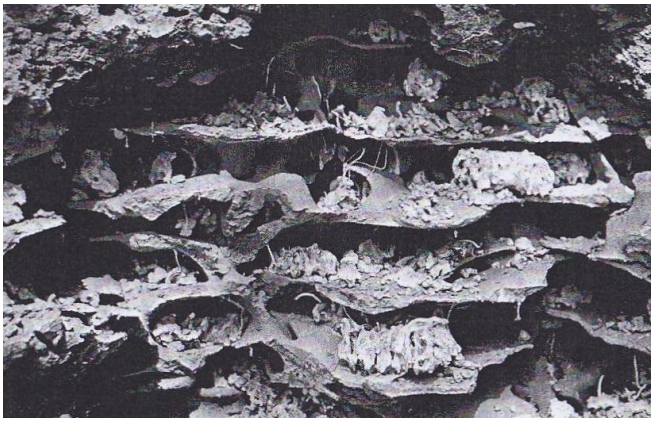
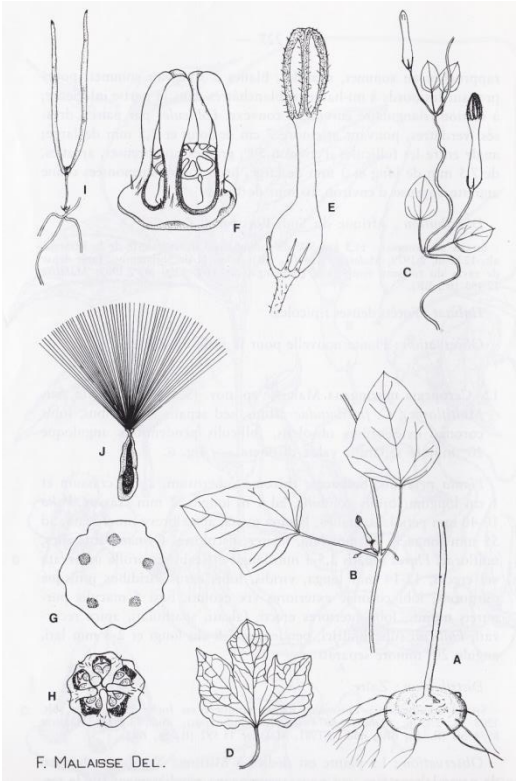


Fig. 16. Inner view of a big *Macrotermes falciger* mound with numerous mushroom beds (Luiswishi miombo open forest) © Léon LEMAIRE (†).

Some comments concerning two plants will be given. First *Ceropegia muzingana* Malaisse is only known form 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).



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.

Fig. 17.- *Ceropegia muzingana* Malaisse

On the other hand, *Diospyros mweroensis* White is a short semi-deciduous tree, that can grow up to 10 m high. The tree is dioecous, the female plant produces ovoid fruits. It's local name is « katula ». The tree can be found at the base and side of termite mounds

Fig. 18.- Immature green fruits of *Diospyros mweroensis* White.

located in miombo open forest. Distribution is confined to an area of 250 kms by 200 kms, 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. The fruits are frequently collected one or two days before fishing. In this case, the men and women who will take part in the fishing 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 (fig. 13, nr 25).

5. TERMITOPHAGY, A SURPRISING WORLD TO DISCOVER

At least 32 species of termites, that is to say 1.03% of the world diversity, are eaten by Man. They belong to seven families, Macrotermitidae (13 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, Thaïland, Philippines and Malaysia), in Oceania (Indonesia, Australia) and in Africa (see below).

The consumption of termites in Africa has been covered in more than 275 papers and books. The oldest reference known for Africa is given by Labat in 1732 (on page 183) who reports 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) de Serpa Pinto (1881), Baumann (1887), Drummond (1888) and Stuhlmann (1894).

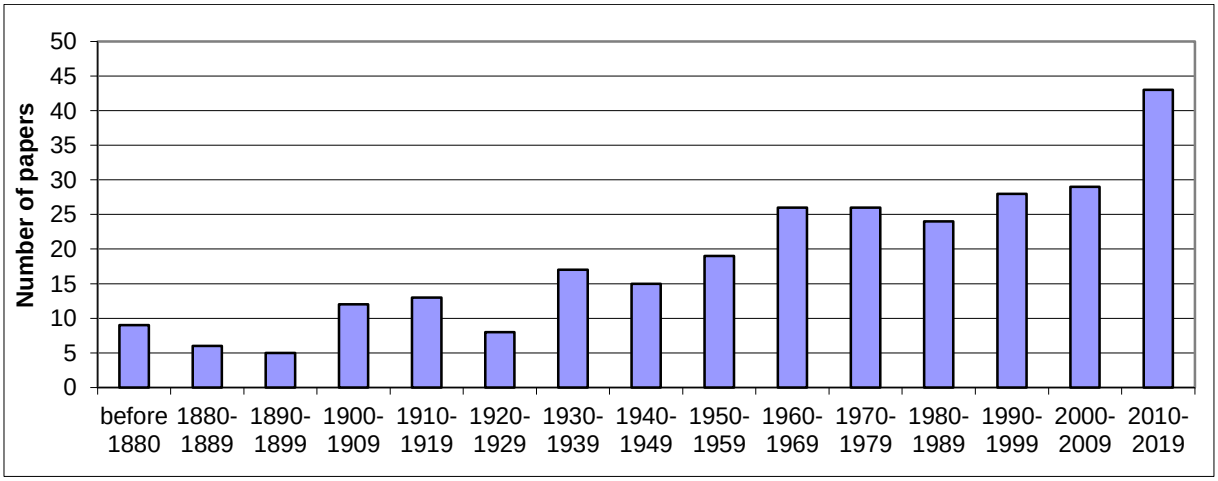


Fig. 19. Number of publications with comments about termitophagy in Africa.

Some exhaustive studies deal with ethnological and ecological aspects, including termitophagy. They are notably 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 decades.

At least 18 different species belonging to two families and four subfamilies are consumed in Africa (Malaisse, 2010, p. 247). The number of different ethnospecies of termites eaten varies according the ethno-linguistic 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.

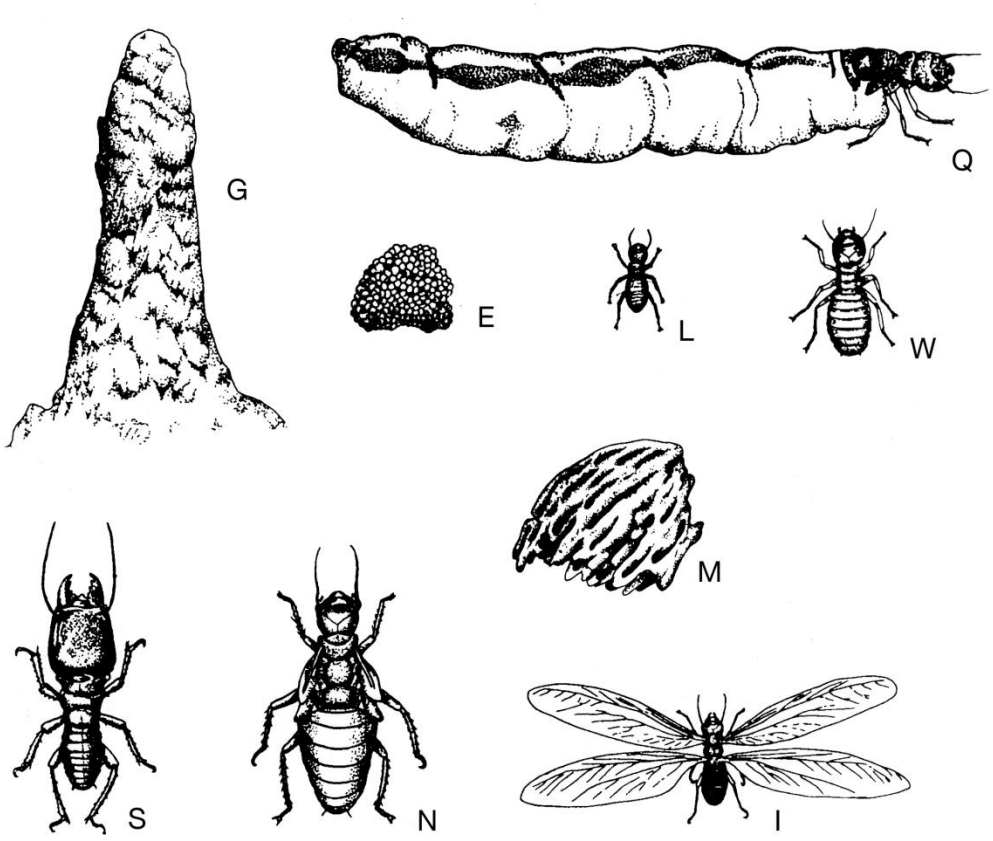


Fig. 20. Diversity of items in termitophagy (E = eggs ; G = geophagy ; I = imago ; L = larva ; M = mushroom bed ; N = nymph ; Q = queen, S = soldier ; W = worker) (Malaisse, 2010).

From a study of 250 diverse ethnolinguistic groups, the respective importance in decreasing order of the nine items is: imago (226 groups, 90.4%), queen (64 groups, 25.6%), soldier (25 groups, 10.0%), nymph (13 groups, 5.2%), mushroom bed (5 groups, 2%), geophagy (6 groups, 2.4%), eggs (3 groups, 1.2%). The consumption of larva and worker was not taken into consideration, whilst the use of oil obtained from adults and used for cooking (soup or sauce) was quoted by 6 groups or 2.4%.

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

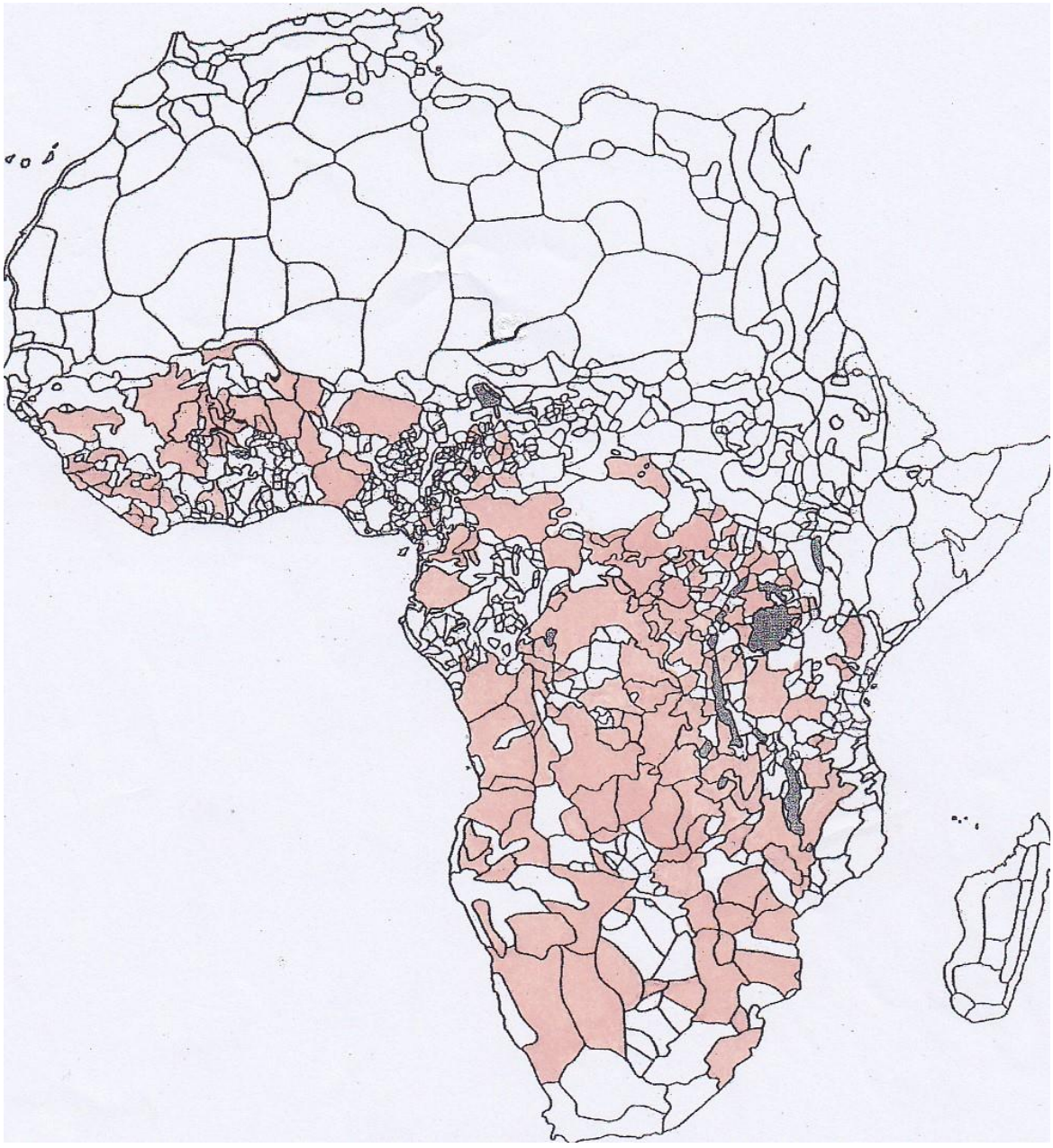


Fig. 21.- Areas of Africa concerned with termitophagy. Each area concerns one ethno-linguistic group. An inventory of 1020 ethno-linguistics groups has been made for Africa.

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 shrubs 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-sizes bricks. The bricks are air dried, stacked, then fired with wood from the neighbouring open forest.

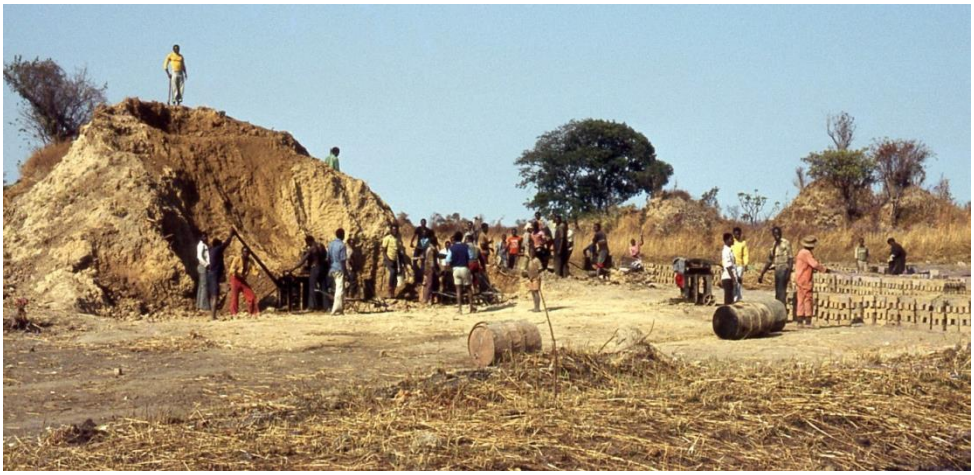


Fig. 22.- The termite mound located at the left furnishes the bricks © Léon LEMAIRE (†).

Fig. 23.- Great activity at the foot of the mound. © François MALAISSE

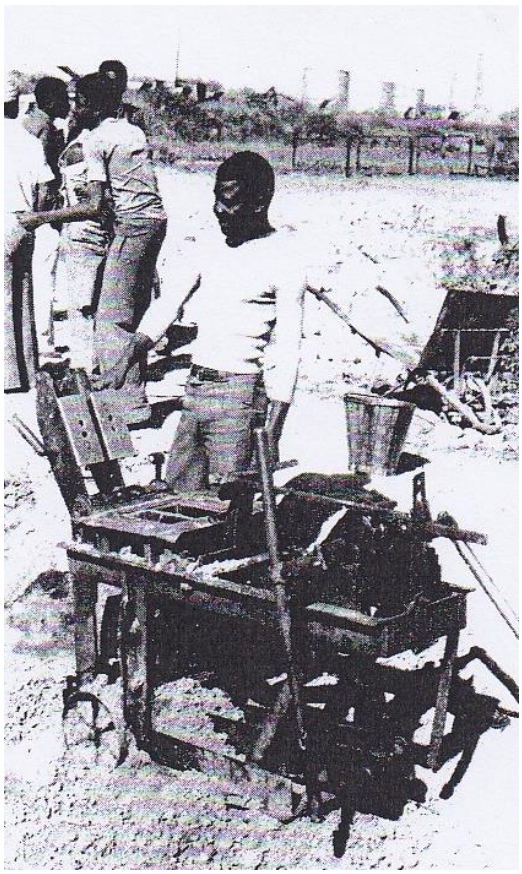


Fig. 24.- The hand operated brick press.

The average production is 271,000 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 30,000 bricks. On the basis of this reasoning we have been able to 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 600,000 in habitants. A simple calculation shows that a density of two termites 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. 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 125,000 to 700,000 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).

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 quoted. This is notably the case of construction of cereal crop stores by the Mofu of Northern Cameroon, as well as plastering wall surfaces by the Mossi of the central shelf of Burkina Faso (Dezwaene, 2004).

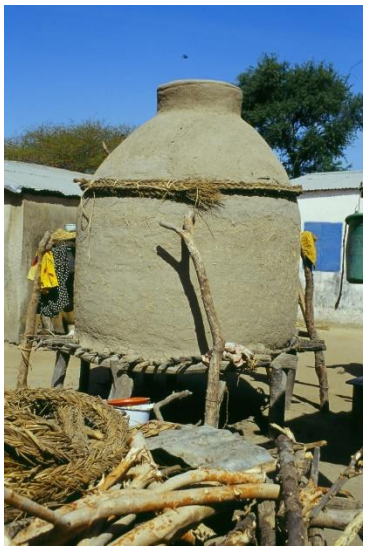


Fig. 25 and 26.- Cereal lofts constructed by the Mofu of Northern Cameroon

6.3.- Termite mound soil used for native copper smelting furnaces

The use of termite mound soil has been quoted for diverse uses. Verbeken and Walraet (1953) have published a fine photo of a native copper smelting furnace used for smelting malachite for making copper castings and crosses. We have got the chance of discovering remains of such a furnace on the slope of a termite mound.

Fig. 27.- Remains of two copper smelting furnaces on the slope of a termite mound in the area of Kwatebala © François MALAISSE

6.4.- Termite mound soil for making house walls.

At Mâh, near to 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, personnal communication).

Fig. 28 : Fragments of « Ikou » mound.

Fig. 29 : « Ichion » termite mound.

Fig. 30 : Traditional termite house.

© Edmond MIABANGANA.

7. CULTURAL ASPECTS

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

7.1.- Distinction and recognition of termites and termite mounds

First, 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(=concerning) four edible species, the hours of swarming are : 18-20 hours (*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 the termites varies greatly according to the various ethnolinguistic group.

Flying termites are caught when going on their wedding flight. Figure 32 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.

31/1 Manual picking 32/2 Catch when flying 31/3-4 Opening of termite mound

31/5-6 Covering up of termite mouds in Gabon 31/7 Luminous trapping

Fig. 31.- 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 of 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). 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 of 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, with water, is places 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 imago in the large termite mounds. Women must not have sex the day before collecting, nor be obviously 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 exist. Termites are also squeezed to obtain a culinary oil, who is used locally to prepare a soup or sauces. 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 attracting birds. In several parts of Africa they are used in this way. We have chosen one example from Lower Kongo, one other from Upper Katanga.

In Lower Kongo, when the 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 soil. Some get stuck in the lime and villagers catch them (Aloni K., pers. comm.; Latham & Konda ku Mbuta, 2014).

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

© François MALAISSE.

7.5.- Villagers or chief of village owners of termite mounds and/or queens

In several ethno-linguistics 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 to my termite mound! ». For instance collecting of mushrooms on termite mounds is frequently a social activity. Such ownership has, for instance, been quoted for the Zande (De Schlippé, 1956). By diverse groups, the queen may only be eaten by the chief of the village. This is notably the case with the Bangala in the vicinity of Mobwasa.

7.6.- The place of termite mounds in myths

The origin of the world myth among the Dogon of Maly Republic is a fine example. It is as follows: The stars are lumps of soil thrown into the universe by God, Amma. That was the begin of the earth, « a pudding of clay » ; in fact it was a woman who possessed an ants'nest as a sex symbol and a termite mound as a clitoris. God wanted to unite with this creature, but,

Fig. 34. Villagers collecting mushrooms © Léon LEMAIRE (†)

Fig. 35. Plenty of mushrooms on termite mounds © François MALAISSE

at the moment of the act, the termite mound stands up, providing its ambiguity and its partial masculinity in this way and shutting off the access. This setback irritated God, who cut downs 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.

7.7.- The importance of mushrooms of termite mounds in myths

Oso (1976) comments 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 wisdom, *Olodumare* has a deputy on earth known as *Orunmila*. Oral traditions emphasize the part played by *Orunmila* in guiding the destinies both of the divinities and of men. Yoruba consult *Orunmwila* 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 the distant past, of a man, *Ogogo*, who had bad luck, and who never succeeded in anything he put his hand to. *Orunwila* examined his destinity 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 that he had been cleansed 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 », points 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, on pain of falling ill.

On the other hand, « 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, south-west of Sudan and north-east of D.R. Congo. Our information concerning this oracle is furnished by Evans-Pritchard (1937).

This oracle entails 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 », in the tunnels and to return the next day to see which sticks have been eaten (fig. 36). The response depends on the way in which the question was 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 » ; on the other hand, the « abio » termites frequently lie ! The place where the two sticks are inserted into the mound varies with the termite species concerned.

Fig. 36.- The stick on the far right has been termite-eaten. When the consultation is finished, the sticks are rolled up in a leaf (see near right), and these are brought back at home (Evans-Pritchard, 1937).

7.10.- Denomination of some periods of the year

Termites have been for a long time used by some ethno-linguistic 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 (presently Lubumbashi).

8. TERMITES AND TERMITE MOUNDS ARE SOURCE OF WISDOM

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

As explained in the introduction termites are social animals and comparisons with our social live 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 Ethnologue, 1020 distinct linguistic groups are to be found in Africa. We decided to try to put together as many proverbs as possible, etc. involving the greatest number of ethno-linguistic 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 this last several

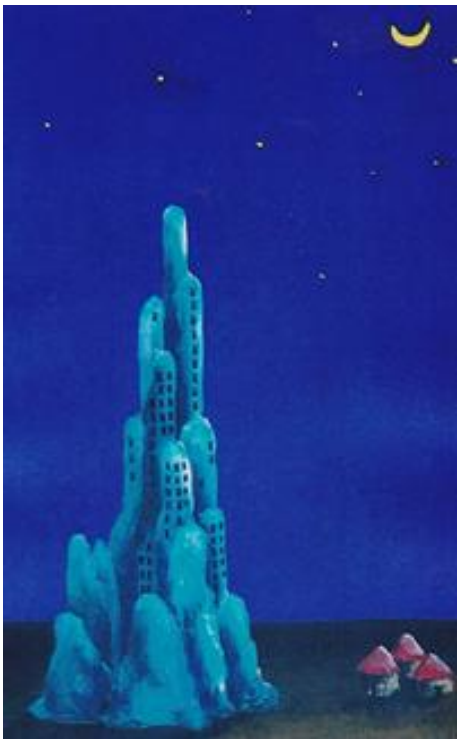
possibilities exist. If the proverb had already been published, the author and references should be given. If the proverb had not been published, we requested the name of the informant as well as the name of our collaborator who had been able to collect the information.

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 written ; 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. Presently we have 207 proverbs relevant from 90 ethnolinguistics groups located in 62 countries.

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

Example 1: A Mòoré proverb, written in French by Bonnet (1982, page 107).



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As high that a termite mound could be, it never will reach the moon.

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, nevertheless 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.

Example 2: Cokwe [Angola] proverb, provided by SAKAWANGA Zacarias *fide* DIKUMBWA N'Landu (unpublished)

© Michel SCHAIJES (†)

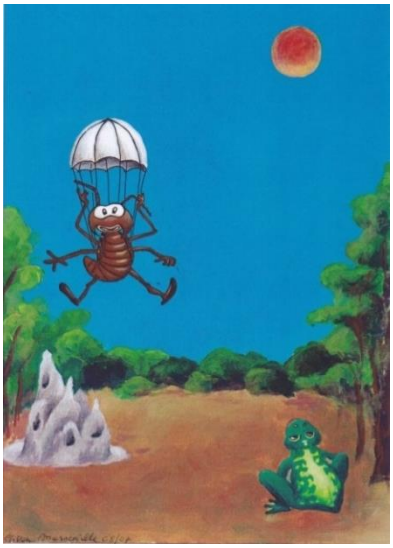
Wording: « Kenene/zondola/kaswa ».

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 (see photo left). They particularly check that it is not to dark and that no-one is walking around. If all is well, they return into the mound and tell the winged termites that they are free to go out.

Example 3: A Bemba proverb (in Lomotua dialect), provided by KISIMBA Kibuye Emile (†) and CABALA Sylvestre (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 him ».
- Comments
  This proverb is enounced to clear. In fact, “I do not tempt anyone, it’s them who tempt me!”



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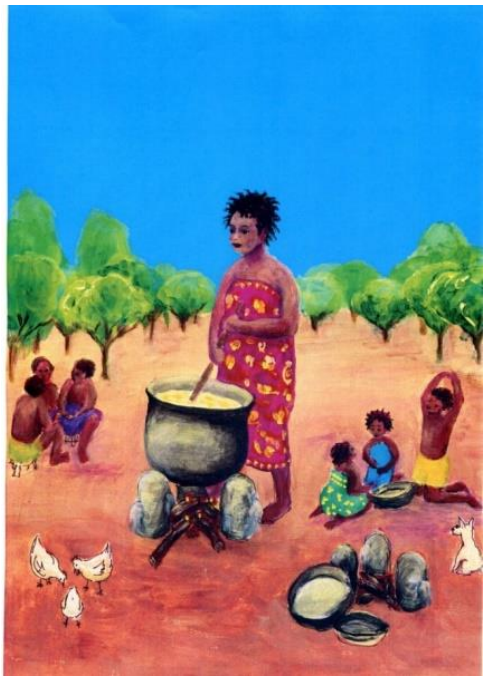
An analogue proverb has been quoted for the Igbo people of Nigeria, namely “After flying the termite will fall to be eaten by the toad”.



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Example 4: Kongo proverb, provided by ALONI Komanda Jules (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 ».

- Comments

Given as a reproach, this proverb is devoted to persons who neglect team solidarity. He remembers that alone we are weak. There is some similarity with the French « L'union fait la force ».

Acknowledgments

I received considerable support from several people. Mr. Paul LATHAM corrected the first English draft ; Ms Stéphanie DAVISTER, from Gembloux Agro-Bio Tech, provided plenty of references requested. Thank you both for your swift actions. A special world of thanks to the following individuals who provided several slides for our use (in alphabetic order) : Ir. Willy BASSA DHEU (fig. 31/1,2), Dr. Rumsaïs BLATRIX (fig. 9), Dr. André DE KESEL (fig. 15), Dr. Muaka MBENZA (†) (fig. 31/5,6), KALAMBAY (fig. 23 and 24), Ir. Patrick KASANGIJ (fig. 14), Léon LEMAIRE (†) (fig. 16, 34), Dr. Edmond Sylvestre MIABANGANA (fig. 29-31), Dr. Moumouni OUEDRAOGO (fig. 31/7), Dr. Jolanta PRZYBYŁOWICZ (fig. 6), Dr. Cédric VERMEULEN (fig. 31/3,4).

For gathering information and putting the proverbs at our disposal, we acknowledge Dr. Jules ALONI KOMANDA, Dr. Sylvestre CABALA, Dr. DIKUMBWA N'LANDU, Émile KISIMBA KIBUYE (†), Dr. Sylvestre CABALA, Dr. Germain MABOSSY-MOBOUNA and Dr. Edmond Sylvestre MIABANGANA, and for painting three watercolours and one ink drawing Christiane VAN MARSENILLE.

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