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ARTICLES

Shadowlands and dark corners

An anthropology of light and zoonosis

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Abstract

Viral haemorrhagic fevers (VHFs) persist in darkness. The pathogenicity of viruses like Lassa, Marburg, and Ebola is partly explained by their ability to survive on surfaces outside their infected hosts, provided they are not exposed to heat, disinfecting chemicals, or ultraviolet light. Taking these basic virological insights as our starting point, we seek to elaborate ethnographically the links between disease transmission and gradations of luminosity. An interdisciplinary research project into the control of Lassa fever in West Africa provided the empirical prompt for this article, which we then extended through our experience working in the region during the 2014–2016 Ebola virus outbreak. The spectral dimensions of zoonotic exchange and the apprehensions they engender help us come to grips with the complex interface of viral biology and human-animal sociality, and, we suggest, add nuance to global health framings of disease transmission and control.

Keywords

light, Lassa fever, Ebola, multispecies ethnography, global health, West Africa

Introduction

> The rats climb onto the rug when the guests are not looking, when the lights are out, when the party's over. It's nighttime, black. What happens would be the obscure

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> opposite of conscious and clear organization, happening behind everyone's back, the dark side of the system. But what do we call these nocturnal processes? Are they destructive or constructive?
>
> – Michel Serres, *The Parasite*

> At night, we can hear the baby mice weeping. Sometimes they lick our fingers.
>
> – Resident of Sokurala, Guinea

Exposure to direct sunlight is generally a good way to kill viruses. Though the speed at which inactivation occurs will depend on the nature of the viral envelope and the time of day, ultraviolet (UV) rays penetrate, alter, and destroy genetic material (Lytle and Sagripanti 2005). Viruses consisting of single-stranded nucleic acids – for instance, those responsible for haemorrhagic fevers like Lassa, Marbug, or Ebola – are particularly photosensitive, because they are unable to repair damage in the absence of a complementary strand. The size of the virus can also increase susceptibility: the bigger the target, the more damage wavelengths of light cause (Kowalski, Bahnfleth, and Hernandez 2009; Powell and Setlow 1956).

These insights into the effects of sunlight on viruses have led to the development of UV light technology for disinfection in laboratories, health facilities, and biosafety cabinets (Elliot, McCormick, and Johnson 1982; Meechan and Wilson 2006). The natural decay of viruses in the dark has received comparatively less attention; indeed, the dynamics of viral persistence outside of the host raise a number of questions about the relationships among surface materials, ambient conditions, and genetic resilience (Sagripanti and Lytle 2011). These questions gained amplitude during the 2014–2016 Ebola virus outbreak in West Africa. For instance, the policy of burning the personal belongings of those who had been infected by the virus had tremendous consequences for survivors as well as for the families of the sick. The reliance on chlorine in isolation wards, moreover, complicated the archiving and transfer of patient records and documents, which could not be adequately disinfected without destruction, hampering clinical decision making, research, and care (Bühler et al. 2014). Knowing more about the impact of direct sunlight on the residual infectivity of Ebola could have made a considerable difference to the efficiency and acceptability of the outbreak response.

That darkness entails its own particular vitalities is an anthropological truism. The ethnographic record on the sociality of nightlife is rich. Accounts of wakefulness and dreaming; the labour and lifestyles that are enabled by artificial lighting; and the tombs, hearths, and hideaways that safeguard what is sacred have opened new conceptual avenues

that unsettle the binary of day and night (see for example Bille and Sørensen 2007; Chappatte 2014; Cross 2013; Schnepel and Ben-Ari 2005). Indeed if, as Tim Ingold (2000, 265) suggests, 'light is an experience of inhabiting the world of the visible' – an agent of revelation, sincerity, and cosmological transformation – then darkness would then constitute a radically distinct phenomenological experience, characterized by discretion, concealment, pleasure, reversal, and persistence.

Nowhere are the multiple 'chronotopes' of shade and luminosity more evident than in recent ethnographic accounts of multispecies life.[1] From interpreting an Amazonian dog's dreams (Kohn 2007) to foraging for mushrooms in the shadow of an oak tree (Tsing 2012), investigations of the spaces humans and nonhumans share reveal the convivial operations that occur at the edge of visibility. Sight is often secondary to these experiences; trapping reindeer in the snow, cultivating ornamental gardens, and studying the behaviours of bonobos all demand a retraining of attention through sound, smell, and touch (see for example Archambault 2016; Dave 2014; Despret 2004; Willerslev 2004). Proximate in ways we often cannot (or would rather not) see, multispecies relationality complicates how we understand communication and consciousness. Becoming aware of the nonhuman is an unsettling enterprise, 'the nightmare of knowing and the nightmare of non-recognition', as Hugh Raffles (2010, 202) puts it, 'the nightmare of turning the overhead light on just as the carpet scatters'.

This article seeks to elaborate ethnographically the relevance of the spectral dimensions of multispecies encounters for global health research and interventions. Our prompt for this analysis was an interdisciplinary study of the eco-epidemiology and control of Lassa fever in Sierra Leone and Guinea. The anthropological focus of that research was the experience of living with the multimammate rat[2] – *Mastomys natalensis* – a species common to sub-Saharan Africa and the primary reservoir for Lassa fever capable of spreading the infection to humans. Examining the daily efforts of humans and rodents to occupy domestic space

[1] 'Chronotope' captures the complex material and social realities in which time is experienced. In Donna Haraway's (1997, 41) terms, it is 'topical time, or a topos through which temporality is organized. A topic is a commonplace, a rhetorical site. Like both place and space, time is never "literal"'.

[2] Throughout the paper we use the term 'rat' in describing the rodents that focus our ethnographic concern. In the public health literature, the vector of Lassa fever, *Mastomys natalensis*, is referred to alternatively as the 'multimammate mouse' or 'multimammate rat', the latter indicating the common understanding of the species as the 'African rat'. The local taxonomies of rodents tend to vary according to where the animal is mostly seen (see for example, Bonwitt et al. 2016). For the purposes of our work, our use of 'rat' includes all commensal rodent species that tend to nest within domestic spaces.

revealed the central role light and its absence play in bringing humans, rodents, and the viruses they carry into contact.

We develop these insights into an argument suggesting the significance of light for disease transmission and control in two directions. First, we argue that the ethnographic apprehension of the vicissitudes of brightness, illumination, and shading force us to refine the spatial units that underpin outbreak response, research, and policy, specifically the role of the household as a site of contact and contamination. Seen from the vantage point of the rat-human interface, the house is not a single and consistent built environment but rather consists of assemblages of thresholds, furnishings, wall fissures, and dirty dishes, each with their own particular vitality depending on the season or the hour of the day. We suggest that rather than the house per se, the intersection of night, day, and the crepuscular behaviours of humans and rats provide the key biosemiotic scaffold – or patterns of biological interaction and exchange – necessary for Lassa transmission (see for example Hoffmeyer 2008).

Second, giving ethnographic priority to the diurnal and nocturnal rhythms of human-rat encounters serves to foreground the forms of attention that these interactions involve (see Kelly and Lezaun 2017). Hunting rodents with sticks in the garden and ignoring the scratching and squeaking coming from under the bed are distinct moments in multispecies domesticity, moments characterized by different intentions, aims, and habits. The tenor and pacing of these encounters and not merely their location in space and time impact their pathogenic potential. Attention to these practices of awareness, avoidance, surprise, and disregard pushes us to be far more nuanced in our understanding of the competencies involved in disease control.

We believe that thinking through how light and darkness mediate rodent-human relationships offers conceptual dividends for analysing the spaces and epistemologies of disease transmission more broadly. These lessons were borne out during the 2014–2016 West African Ebola outbreak, which dramatically reoriented our work, logistically, empirically, and ethically. Based in the neighbouring district in Guinea from where the first cases of Ebola were confirmed, our Lassa research project suddenly ground to a halt. Epidemiological research involving blood samples was no longer viable; local populations became increasingly wary of foreign research teams and were no longer interested in opening their homes to surveillance activities. In the meantime, like other anthropologists with regional expertise, we sought to support the international response to the Ebola crisis,

working with relief organizations and clinical research teams, and preparing policy briefs for governmental and nongovernmental bodies.[3]

To say that the epidemic caught us by surprise will sound hackneyed. But thinking back on that shock – and the forms of attention and action it precipitated – is, we believe, instructive. Like other contributions to this special issue, we are concerned with how anthropology can help grasp the complex drivers of zoonotic transmission. But, equally, we hope to advance a new kind of interdisciplinary work that will interrogate the epistemologies of infectious disease research: the key narratives, discourses, and concepts that structure how pathogenic exchange is understood and controlled. As a structuring metaphor for global health, light belongs to a particular cartography of disease control, which, we argue, obscures the multiple, mundane ways humans and nonhumans negotiate the hazards of life together.

Bringing Lassa to light

> During our first days in Faranah, while the laboratory technicians were performing rodent necropsies, a boy brought a rat in his hands: 'my father told me to give you this'. When asked when he killed it, he explained: 'This morning I opened the door of the kitchen and I saw the mouse running. I threw a stick and killed the mouse. We usually eat them but my father told me that I should give it to you'.
>
> – Marí Sáez's field notes, November 2013

At dusk, a team of five field researchers meet at the centre of Sokurala, a Malinka village on the eastern Guinean border with Sierra Leone. They proceed along a straight line, parallel to the road, stopping at each house in their path until they reach the edge of the village. In the bed of the truck is a crate of metal boxes: foot-long, collapsible, live-animal Sherman Traps. The team baits each trap with a mixture of peanuts and dried fish, prepared in front of a gathering crowd. At each house, a member of the team greets the owner of the house, shows him or her the trap and explains, one more time, the purpose of the study; this explanation had been the subject of village meetings with local authorities and residents weeks before work began. If permission to enter the house is granted, the team member, with help from

[3] Marí Saéz contributed to the first ecological studies of Ebola spillover (see Saéz et al. 2015). Kelly served as a member of the WHO's Strategic Advisory Group of Experts (SAGE) on Ebola Vaccines and Vaccinations (see Kelly 2018). For further examples of anthropological engagements with the response, see: http://www.ebola-anthropology.net/.

the resident and a headlamp, will scan the room for its darkest corners – under the bed, behind a bag of rice, alongside a hole in a wall – the most strategic places to set the traps.

In the early morning, the team retraces its steps, visiting all the houses where traps were left the previous evening. Residents alert the team if the trapping was successful, indicated by the unmistakable sound of claws against metal. Once all the traps have been collected, the team drives out to an open space selected by the village chief at the edge of the village, and sets up a folding table with four plastic chairs. Across the surgical sheet a number of items are laid out: scissors, forceps, latex gloves, paper towels, data sheets, pencils, disinfectant squirt bottles, and a corkboard with pins. Just beyond the table, a couple of young village boys help dig a pit. The whole area is marked off with security tape.

Four people are needed to perform rodent necropsies: one to remove and euthanize the rats that have been captured in the traps, another to dissect the animals, a third to take notes and label the samples, and a fourth to refresh the material on the table and to take pictures. The team works with intense concentration in the heat, their gloved hands performing an automated choreography, taking measurements of the rodent's body, dabbing cardiac blood on filter paper, opening the belly, removing eyes, spleen, and liver. All samples are conserved in alcohol. When the dissections have been completed, sample jars are placed in a cooler; instruments, gowns, gloves, and face shields are disinfected; and disposable materials are burnt in the pit. Traps are cleaned with chlorine and put out to dry in the sunlight.

These are among the daily operating procedures of 'Lassa Fever in Guinea and Sierra Leone: Rodent Control, and Seasonality of Human Exposure to Rodents' (LAROCS), an interdisciplinary public health project investigating rodent control as a means to reduce the spread of the Lassa virus in Sierra Leone and Guinea. Lassa fever is endemic in the Mano River region, but has shown an increasing incidence across West Africa, with cases appearing in Ghana and most recently in Benin, where, during the height of the recent Ebola epidemic, an outbreak killed nine people. [4] A viral haemorrhagic disease, Lassa shares a number of clinical features with Ebola (high fever, vomiting, diarrhoea, internal bleeding), but because the majority of cases are asymptomatic, its overall case fatality ratio remains comparatively low, between 1 and 2 per cent. When symptoms do occur, however, they tend to be severe. Treatments such as intravenous ribavirin (a broad-spectrum antiviral) can improve survival but therapeutic success hinges on early diagnosis, which, owing to the nonspecific nature of the disease and the general shortcomings of the health care system, can be complicated. It is

[4] An American nurse who contracted the disease in 1969 while living in Lassa, Nigeria, was the first recorded human case. She subsequently infected five people, three of whom died.

estimated that Lassa fever is responsible for anywhere from two to five thousand deaths in West Africa every year (McCormick and Fischer-Hoch 2002).

Figure 1. Necropsy in Sokurula. Photo by the authors.

The mechanisms of Lassa transmission within rodent populations are poorly understood. Ecological research undertaken over the past decade points to a clear link between agricultural practices and rodent distribution (Gibb et al. 2017). Following the harvest, when bags of grains are stored in homes, rodent numbers within the village have been found to increase rapidly. A greater abundance of rats, however, does not necessarily correlate to the prevalence of the Lassa virus within the rodent population. During the rainy season, rats have been found to be two or three times more likely to be carrying the virus than in the dry months (Fichet-Calvet et al. 2007). Different hypotheses have been given to explain this seasonal variability: heightened reproduction may mean that mothers are more likely to pass on the virus to offspring; alternatively, with less food available, territorial biting among males might lead to an increase of Lassa prevalence in the population (Granjon and Duplantier 1993; Fichet-Calvet et al. 2014).

In short, whether or not a local resident is likely to become infected with Lassa fever is not necessarily a function of the number of rats in the village at any given time (Davis, Fichet-Calvet, and Leirs 2005). The infectivity of the reservoir (the organism that harbours the virus) and the frequency and patterns of rodent-to-rodent and human-rodent contact all affect the risk of Lassa spillover from one population to the other. In general, human

infection is thought to occur through direct or indirect contact with rodent excreta, when food, water, utensils, and other surfaces are contaminated with rodent urine, faeces, mucus, or blood. Efforts to characterize the ecological mechanisms of Lassa exposure have demonstrated that humidity, rainfall, and temperature play important roles in mediating the relationship between rodent abundance and disease incidence in human populations (Fichet-Calvet and Rogers 2009). However, rodent behaviours are so attuned to their human hosts, and so embedded in the daily activities of village life, that regional transmission patterns are difficult to extrapolate. An effective strategy of Lassa disease control thus hinges upon a granular understanding of the interactions that bring humans and rodents into contact (Dzingirai et al. 2017).

How the human-rodent relationship unfolded within domestic spaces provided a key focus for LAROCS' interdisciplinary mission. The fact that *M. natalensis* is highly commensal suggests that rodent behaviours – territoriality, promiscuity, dispersal range, and reproduction rates – are conjugated by the material specificities of the domestic environment (Borremans et al. 2014). An unused suitcase, for instance, can offer a capacious enough space for group huddling and grooming; the stacked firewood or the gutters and ridges that form along concrete floors can provide sufficient cover for foraging for food. Thus, while the biologists in LAROCS sought to come to grips with rodent abundance and pathogenicity within a particular village, the anthropological component of the project was focused on giving ethnographic depth to the domestic contexts of zoonotic interaction, including the construction of buildings; the arrangements of belongings, tools, and equipment; the distribution of litter; and the paces and spaces of household maintenance, cooking, farming, gardening, etc. Knowing more about who was likely to come across a burrow at what time of day, and at what point during the year, the team believed, could help to clarify the local risks of Lassa infection and the potential impact of rodent control methods.

But even further, the pathogenic relevance of these spaces – the intensity and extent of physical contact – relates to the particular circumstances under which these meetings unfold. The boy's appearance at the dissection table in Faranah provides a useful point of departure. The collections from the traps provide one take on rodent-to-human cohabitation, a proxy for how many rats are present in the house at night. The presentation of the dead rat by the boy offers a different one: here we gain insight into a set of distinct sites and practices of convergence, the sudden pursuit of an animal hiding behind a closed door. Soon after our fieldwork began, questions about the seasonality of rodent populations gave way to narratives of surprise, avoidance, disturbance, and indifference. These stories were mediated by the quality of light, unfolding around networks of shadows, hidden traps, and sudden movements and noises in the dead of night. As an ethnographic anchor, light (and its absence) disclosed the mutability of the house; roof, walls, and floor were not only

containers for domestic life but 'places in which the to and fro of life unfold' (Carsten and Hugh-Jones 1995, 1).

In the corner, out of sight

> The dark, nocturnal, lower part of the house, the place for things that are damp, green or raw – jars of water placed on the benches on either side of the stable entrance or next to the wall of darkness, wood green fodder – and also the place for natural beings – oxen and cows, donkeys and mules – natural activities – sleep, sexual intercourse, childbirth and also death.
>
> Pierre Bourdieu, *The Kabyle House*

In his classic study of the Kabyle House, Pierre Bourdieu (1977) analyses the cosmological symbolism of the architectural and aesthetic arrangements of residential space. The management of available light provides the idiom through which Berber notions of gender, hospitality, and kinship are articulated: the orientation of a door to the east or the placement of a loom against an opposing wall do not merely reflect practical considerations but also cultural values. Weaving with her back to the windows, in the shadow of a loom, a young girl is kept out of sight, her virginity protected (Bourdieu 1977, 137). In Bourdieu's account, darkness forges links between home and habitus, connections made through intimacy with nature: 'the dark part', he writes, 'is full at night, full of human beings and also full of animals' (Bourdieu 1977, 138). For Bourdieu, that 'fullness' underwrites the shadow's symbolic register as a space of fertility; in our case, it also speaks to its pathogenic potential.

Before exploring those dark spaces, let us first offer a brief sketch of the sort of residential setting we encountered in our project. Across the forest-savanna mosaic that characterizes the eastern-central Guinean region of Faranah, most houses are built in the round, out of mud, wattle, and thatch. As elsewhere in West Africa, extended Malinke families inhabit a 'concession', a number of single-room structures (including a shower and a kitchen) distributed in a circular fashion around a courtyard and managed by the household patriarch. Huts often have no internal divisions, though some residents use a curtain to separate off the bed and other personal belongings from a more public space used to welcome visitors. Most huts are also built with a small wall or ledge in front that serves as a space for rest, protected from the sun and rain.

Men and women tend to live separately. Women's huts are recognizable by the sheer number of items, including pots, cups, saucepans, jars, jugs, and platters from the bride's trousseau. These objects and everyday clothes are often hung from strings from the ceiling; cooking

materials such as condiments, rice, peanuts, and vegetables are arranged on the table or stored in a wooden box off to the side on the floor. Women use the space in front of the houses to dry rice, cassava, and *Parkia biglobosa* (néré fruit), the essential ingredient for *sumbara* (a pungent condiment relished by both humans and rats). Most social activities – chatting, braiding hair, playing with children, and entertaining visitors – take place here. The back of the hut is reserved for cooking and is where trash is generally discarded.

A bicycle leaning against the wall, a machete or shotgun hung near the door – these possessions indicate that the hut belongs to a man. Growing up, boys tend to sleep together with friends and smaller brothers until they are ready for marriage, at which point it is customary for the concession head to provide each young man with a private residence. These first houses tend to be modest in size and may need to be extended to accommodate a young family. A multiroom cement house is regarded as a sign of financial success and is often built with money made from the sale of livestock or from wages earned working in the mines. In contrast to the 'traditional' Sudanese-style mud hut, which is considered without value, these concrete structures are taxed.

The sociality of these domestic spaces has a seasonal inflection. During the rains (late April to November), people prepare the fields for rice cultivation, leaving the village early in the morning and returning after sunset. Small children and the elderly and infirm remain at home, resting, playing, or cleaning, but the majority of the houses are closed. During the dry season, more people remain in the village; it is during this time that rice is pounded, fish caught, tools repaired, new houses built, and old ones refurbished (see for example Fairhead and Leach 1996). Women, traditionally in charge of domestic upkeep, plaster the floor and walls with a mix of cow dung and water, and paint the walls with white, brown, or salmon-coloured clay. Men focus their attentions on the roof: reaping and reweaving the straw and, if necessary, replacing and fashioning bamboo or wooden frames. Because repairs are costly and their structures are believed to be more durable, maintenance of concrete houses occurs infrequently. Only when the roof leaks or crevasses form in the floor or walls will cement be purchased and surfaces replastered.

Our interest in these domestic and peridomestic activities developed from the ways that seasonal variations were believed to contour the breeding, feeding, and nesting behaviours of rodents. The links are compelling: during the dry season, for instance, the burning of fields and the arrival of livestock redirects rodent foraging to the village, where, following the harvest, granaries are filled with bulging bags and husks of pounded rice are scattered across the concession grounds. The remains of *sumbara* or seasoned fish – caught and prepared by women freed from agricultural work – are, apparently, a particular treat. Also during this time, when the Harmattan winds blow haze from the Sahara, it is illegal to cook during midday. After a late meal, dirty dishes are more likely to be left to be washed until morning,

when it is safer to collect water and easier to see, leaving rats their pick of the choicest crumbs (Fichet-Calvet et al. 2014).

It is here, beside the stack of *sumbara*-and-rice-crusted dishes, where multispecies ethnography can offer insight into just how these dynamics may create the conditions for transmission. When asked to describe their experiences with rodents, residents emphasized their intractability: 'they live with us' was a constant refrain. The temporal variations of this conviviality, however, were rarely, if ever, commented upon. Rather, rodents were, above all, a presence most keenly felt at night. The scratching and gnawing of plastic bags, the clattering of plates and cups, the soft padding across a thatched roof, and the pungent odours of urine emanating from hanging clothes: these were incidents that unfolded, vividly and viscerally, in darkness. While the fact that nocturnal species are most lively at night is hardly remarkable, how residents responded to that activity is worthy of note. 'At night', one woman commented, 'when you eat in your room you don't wash the plate and sometimes grains of rice fall on the ground. You can sweep the grains of rice and leave them in a corner, or you just leave them like this on the ground. Rodents will come and eat them'.

The intimacy of these nocturnal encounters prompted strategies of accommodation. Attempting to expel or frighten rodents from the house was largely regarded as futile; scratching, clawing, scuttling from plate to burrow all formed part of the phenomenology of the household at night. Instead, sweeping crumbs into a pile at one end of the room was one way that residents sought to direct rodent itineraries away from their bed frames and mattresses. This practice of distanced coexistence takes some work, a suspension of attention made possible by a deep familiarity with rat habits and habitats. Accustomed to their nighttime machinations, the commotion that rats make is easy to recognize. 'I only light the lantern', said one boy, 'when I think it is snake'.

The 'sensory labor of attuning' (Stewart 2011, 450) to rats in the dark is inscribed in the built environment, in the walls, rooftops, and containers that show the wear of rodent infestation. Cracks that form along the bottom of the hut wall are widened into burrows, which, depending on the size, may be filled with batteries or large stones. But by and large, these holes are left as they are, and significant repairs, such as re-cementing floors or reinforcing metal sheeting, are largely regarded as utterly pointless. 'A day or two goes by and they will find a way back in', a retired army officer commented. He continued: 'If not there, they will find a place between the bags and the suitcases and under the clothes. Mice live with us; our house is their home'.

The overlap of human house and rodent home is knit together by a shifting network of passages, nests, and burrows. Rodents manage to avoid capture or predation by minimizing

their visibility, avoiding open spaces, full moonlight, and the light of day. When rodents move in spaces with natural or artificial light they tend to stay close to the walls or use the shade provided by objects for cover (Duplantier and Granjon 1990; Godsil and Fanselow 2004).[5] One woman took us from room to room, moving an empty container along the wall, under a table and past the bed, to imitate the paths rats might take to avoid human contact. Though rodent traffic may be heaviest at night, darkness is an ever-present feature of the domestic landscape. A ray of sunlight from an open window or door illuminates the immediate surroundings, but it also deepens the shadows cast by heavy wood furnishings, hanging clothes, bowls, plates, and other objects (figure 2). Closing doors to one room, cordoning off a shaded edge of the wall or a hole beneath a table, ensures that at least some areas of the home remain undisturbed. 'Sometimes the mice don't need to build a house', one woman put it: 'you can leave an old plate, or old clothes in a corner you never touch. The mice know that you never go there and the rodent can establish a residence there, and at night it comes out for food'.

Domestic space, in short, can be understood through the practices of avoidance, a series of anticipations and circumventions, a reciprocal and recursive negative response to the 'patterns that connect' rat and human coexistence (Bateson 1979; see also Nading 2013). At night those associations become particularly salient: as humans retire to their beds and rats venture from their nests, habituated modes of evasion and inattention are amplified. While it is in the darkness that rodents erupt into consciousness, those shades and shadows can be curated to redirect contact, delimiting the kinds of inadvertent and unwanted tactility that can drive transmission (Brown and Kelly 2014). Attention to these spectral practices suggests how the risk of Lassa virus infection plays out at scales finer than even the most intimate of social ecologies. An understanding of farming patterns, gardening techniques, and household maintenance can certainly provide clues into the likelihood of exposure, but it says little about the intentions and reactions that underpin these interactions. 'We live together' perhaps comes across as a statement of resignation. It is clearly, however, also an achievement: to quote Anna Tsing (2012, 141), 'home is where dependencies within and among species reach their most stifling'. Crafting dark corners, out of sight, opens up some breathing room.

[5] Gradients of luminosity at dawn or at dusk have been found to influence rodents' foraging behaviours (Duplantier and Granjon 1990).

Figure 2. Sokurula house in the daytime. Photo by the authors.

Concealment and capture

> The rodents live in the bush, but there are two that enter our houses, the white mice and the red mice. The red mice, the reddest of all mice, are the more delicious. . . . Mice, when you close the hut, are everywhere; they are free. As soon as you open the door, they hide.
>
> Boy, Sokurula

Avoidance and restraint neither exhaust the affective tenor of the human-rat encounter nor circumscribe the roles light and darkness can play in bringing it about. As work continued in the villages, the necrospy table became a popular place for children to congregate and watch the proceedings. Along with the blacksmith's son, who had killed the rat and handed it to the team in its early days, village boys provided further insight into the logics and challenges of rodent capture, telling us that mice are everywhere, but rarely in places that you can see. That we were told that the red ones are the more delicious suggests how quickly these animals can shift from pest to pet to meal, from an object of disregard and even disgust to one of desire. The house follows these transformations. In one moment, a door functions as a boundary for activities, people, and species; in the next, it can become a snare. Flung open, it forms the

material assemblage of a domestic hunt: linked with a sharp stick, a quick arm, and an eruption of light, a door can yield a delicious meal.

Rats and mice are eaten in each of the areas that the LAROCS team visited. While the public health consequences of the consumption of wild animals have received increasing scientific and policy attention (see for example Kamins et al. 2015; Paige 2015), the practices and preferences involved in eating rodents have only recently emerged as a distinct field of analysis (see Bonwitt et al. 2017; Brown et al. 2015; Dzingirai et al. 2017). The links between rodent consumption and disease incidence have been difficult to clarify not only because of the situated nature of rodent ecology (Kernéis et al. 2009; Ter Meulen et al. 1996) but also because the topic of rodent consumption is a sensitive one. In Sierra Leone, for instance, people have been reluctant to admit to eating rodents after a series of public health campaigns discouraged the practice. Structured questionnaires and surveys – particularly those administered by foreign researchers – do not readily lend themselves to the subtle discursive exchanges, the jokes and doublespeak, that discussing these topics tends to involve (Bonwitt et al. 2016).

The lack of comprehensive investigations into consumption may also speak to a failure of scientific imagination. Neither a concern for conservationists nor a subject of symbolic elaboration, rats as socially significant actors have slipped through the empirical nets of disease ecologists and anthropologists. Research into local practices of predation, for instance, tends to be constrained by an implicit functionalism that interprets dietary decisions in light of nutritional demands (see for example Fa et al. 2002; Subramanian 2010). While it is indisputable that poverty looms large in the lives of these communities, and that rats offer a ready source of protein, the boy's preference for red rats does not articulate a sense of desperation. Rodent meat is often described as sweet, a taste that many prefer over other kinds of meat, including beef.

Yet, while popular, rodents are rarely found for sale in markets. Rather, rats and mice are pursued opportunistically, generally killed by residents occupied with other domestic activities, such as household maintenance, planting the gardens, or clearing land. As rats not only disturb people at night but can also cause considerable crop destruction, 'hunting' techniques are often, though not always, synonymous with pest control. One common approach that tends to yield high numbers is to catch rodents when domestic structures are dismantled for repair, surprising animals nesting in the thatch or concealed in walls and beating them with machetes or sticks as they scatter in the light. In some instances, particularly when clearing the fields for a new rice farm, people may enlist the help of dogs.

Among the Guinean and Sierra Leonean populations in the LAROCS study area, rat hunting tends to be the province of children. The practice is highly social, often conducted in groups; while there may be some expectation that big catches would be shared with family members, hunting tends to be conducted beyond the purview of parental concern or control. Simply because this activity is primarily undertaken by children does not suggest that the methods are crude. In the LAROCS sites in Sierra Leone, residents deploy ingeniously designed traps developed specifically to catch and kill rats, including such as the lightweight and easily laid *Torley*, constructed from two sticks, the more intricately-crafted *Kongoumie*, and the *Gbushie*, which uses a heavy weight to crush the prey when it takes the bait (figures 3a and 3b).[6]

Figure 3a. *Torley* trap. Photograph by Jesse Bonwitt

[6] Among the project villages in Guinea, bamboo traps used to trap rodents in the house at night were combined with poison; 'it was tiring killing one by one', one resident commented (Marí Sáez field notes, 18 June 2014).

Figure 3b. *Gbushie* trap. Photograph by Jesse Bonwitt

The material culture of hunting is a mainstay of ethnographic literature; at the interface of social practice, technology, and environment, trapping is a highly productive lens through which to parse patterns of human-animal relationality (see for example Nadasdy 2007; see also Corsín Jiménez 2014). Alfred Gell (1996) offers what is probably the most salient, and, from the point of view of classic aesthetics, iconoclastic analysis of a trap's semiotics. Juxtaposing ethnographic descriptions of snares and tools developed for hunting to contemporary conceptual artworks, Gell rethinks these 'artefacts' as dynamic representations and models of social relationships, intentions, and agencies. A rat trap from Vanuatu provides a compelling example of how an animal's behaviours and propensities can be subverted in material form: 'the rat that likes to poke around in narrow spaces has just such an attractive cavity prepared for its last, fateful foray into the dark' (Gell 1996, 29). Baited with palm fruit and tucked in the shadow of a tree or along a shaded wall, the *torley*, found in the Bo district in the Southern Province of Sierra Leone, artefactualizes the rat's *Umwelt* (lifeworld) as well as the trapper's skill and, critically, their knowledge of their prey. Transforming darkness into a lethal infrastructure demands attention, a patient awareness of those spaces one cannot usually see.

These traps and orchestrated entrapments reinforce the interactional complexity attendant to Lassa exposure. While dialectics of concealment and surprise are common to all human-rat encounters (whether humans are seeking rodents out or not) – slowly lifting a container with a stick in hand, prompting an aggressive or defensive reaction – has potentially important

pathogenic implications. The risk of infection associated with butchering rodents is without doubt. But beyond the significance of these activities for transmission, giving ethnographic attention to these instruments and practices of entrapment further unsettles the spatial and temporal assumptions of our research. Human-rodent convivialities operate on the level of the settlement: the pathways and plots between houses, the proximal gardens and distal cultivations, the edges of the forest. While one can identify places where rodents are likely to burrow and breed, the landscapes of hunting and play do not map cleanly onto categories into domestic, bush, or agricultural spaces. Mice, as the boy says, 'are everywhere'.

Finally, the fact that it is children who are most likely to come into contact with reservoir species, through games and play, points to a sociality of zoonotic risk that public health campaigns directed at household hygiene or bushmeat trade often fail to appreciate. The limitations of public health campaigns to grasp the lived realities of human-animal coexistence were revealed most vividly during the West African Ebola outbreak, when governments across the region introduced a blanket ban on the consumption of meat from wild animals. These prohibitions, enforced with fines and imprisonment, amplified local confusions and fears, while doing little to address the pressing issue of human-to-human contagion. Like other measures introduced during the Ebola crisis, the 'bushmeat ban' undermined the norms of coexistence – or what James Fairhead (2016) terms 'accommodations' – that characterize how these communities live with and respond to animals.

Thus far, this article has traced how light and darkness orchestrate rodent-human interactions, in an effort to reveal the complexities of attention, intention, and circumspection involved in multispecies intimacy and, by extension, its pathogenicity. The exceptional nature and scale of the 2014–2016 West African Ebola outbreak led to rapid interventions that were often at odds with a detailed analysis of the microsocial contexts of transmission. As the outbreak shifted from public health problem to humanitarian disaster and global security threat, light and darkness operated as powerful metaphors for the exigencies of containment and control. The regimes of visibility and invisibility that characterized the response to the outbreak found their anchor in the household, as both a unit of surveillance and a site of resistance. Drawing inspiration from our ethnographic engagements with light and darkness as a mediator of human-rat domesticity, in the following section we interrogate the discourses that structured the outbreak response, considering in particular the lived realities of contagion these obscured and the opportunities for control that were therefore missed.

The spectacle of spillover

> Corpses are often buried without official notification. And there are 'shadow zones', rural areas where there are rumors of cases and deaths that cannot be investigated because of community resistance or lack of staff and transport. In other cases health centers are being suddenly overwhelmed with patients, suggesting there is an invisible caseload of patients not on the radar of official surveillance systems.
>
> – World Health Organization

In a press release titled, 'Why the Ebola Outbreak Has Been Underestimated', the WHO (2014) pointed to the proliferation of 'shadow zones' – situations of social upheaval and collapse – as the key driver of transmission. The framing of West African populations during the outbreak response as simultaneously beyond help and agents of their own public health demise has been a focal point of social scientific critique (see for example Benton 2017; Dionne and Seay 2015). The 'shadow zone' belongs to a discourse of securitization that recasts suffering as spectacle and, as Joao Nuñes (2017, 543) argues, 'ultimately reflected and exacerbated the neglect that has historically surrounded this disease as well as the needs and vulnerabilities of the populations that have been most affected by it'. Interrogating the dialectics of visibility and invisibility within the broader context of outbreak control and response has helped to clarify the political consequences of global health attention. Here we would like to extend this critical orientation to reflect on how the idioms of light and dark configured domestic space as a site of contagion and containment.

The awful spectre of the 'shadow zone' for the Ebola response was raised by the intensity of community transmission. Whereas previous Ebola outbreaks had been confined to remote rural areas, in West Africa, the disease infected communities that were both interconnected and highly mobile. By August 2014, the virus had reached coastal cities where informal sprawl, the fragility of local health care, and the presence of international airports together posed terrifying challenges for tracing contact and containment. 'Community resistance' amplified those uncertainties; rather than simply chasing an elusive virus, contact tracers were faced with 'rogue' populations (see Fairhead 2017). 'Off the radar of response efforts' (Dhillon 2015), the outbreak quickly spread beyond the capacities of humanitarian aid; national and international forces were called upon to fight 'an invisible enemy' (Vaidyanathan 2014).

The militarization of the response precipitated a raft of surveillance strategies directed at reworking shadow zones into discrete and visible units. During Operation Ose-to-Ose (House-to-House), for instance, Sierra Leoneans were instructed to stay at home for three days, during which time trained volunteers would provide information about the disease and

distribute soap to encourage hygiene. Operation Watch Yu Neyba (Watch Your Neighbour) and Western Area Surge, also in Sierra Leone, shifted from informational outreach to the identification and, at times, forcible removal of the potentially infected (see Spencer 2015). Quarantine – public health's bluntest instrument – played a key, if not controversial, role in these efforts. An archetypal technique of modern governance, quarantine is based on routine reportage, inspections, and pervasive observation of domestic interiors – 'everyone', writes Foucault (1995, 195), 'locked up in his cage, everyone at his window, answering to his name and showing himself when asked – it is the great review of the living and the dead'. In contrast to the modern impulse to isolate the sick individual, quarantine operates in an anticipatory fashion and is levelled at a whole population, confining those potentially exposed in an effort to catch cases as they emerge. As in the prison, light operates here as a form of enclosure: 'visibility is a trap' (Foucault 1995, 195).

How that visual regime touched down in West Africa and the degree to which its disciplinary scope extended or upended the existing administrative milieu is crucial to understanding the evolution of the outbreak and its distinct trajectories across the region. Annie Wilkinson and James Fairhead (2017) compellingly describe how, on the one hand, quarantine in Sierra Leone was effectively sustained through the Paramount Chieftaincy. While there were some complaints about the lack of transparency of these mechanisms – it was claimed that the 'shadow networks' that structure Sierra Leone's political and economic life were 'lubricated with "Ebola money"' (Fairhead 2016, 22) – concerns over corruption did not ultimately delegitimize disease control interventions. In Guinea, by contrast, the combined legacies of French colonial governance and Sekou Toure's authoritarian rule politicized the response along ethnic lines, triggering intense suspicion and, in some cases, violence.

The key role played by secret societies in the religious, social, and political life of these communities added another dimension to the mistrust generated by Ebola containment strategies. The power of these secret societies, reinforced during the civil wars of the 1990s, rests on a careful orchestration of concealment and revelation (see Jackson 2004; Leach 1994). Marianne Ferme (2001, 3), for instance, points to the ceremonial and symbolic salience of masks, masquerades, and concealed inscriptions in the life of secret societies; 'the powers manipulated through these objects', she writes, 'work best in contained, inaccessible sites – underneath and inside other things'. The resonances between that material culture and the instruments associated with infectious disease control were infelicitous. The fences that barricaded care units, the biohazard suits that covered the faces of health workers, and the accounts survivors gave of the neglect and exposure experienced by patients in overcrowded Ebola treatment units stoked fears of the activities that were hidden from view. The bags and unmarked graves in which bodies were buried precipitated new forms of secrecy to circumvent emergency measures and protect social protocols (see for example

Lipton 2017). Combined with the horrific nature of the disease and the sheer scale of the death, the transgressive nature of biosafety measures rendered, as Fairhead (2016, 24) puts it, 'occult forces . . . callously visible'.

Maintaining the delicate balance between discretion and transparency, candour and conciliation is, of course, the central challenge to any public health intervention during a public health emergency. In the case of the Ebola outbreak, the cultural salience of visibility reinforces the importance of contextualizing strategies of disclosure – thinking through what can be done and to whom, through what means, and at what moment – during a state of emergency (Lynteris 2014). Largely a top-down effort, the Ebola outbreak response relied on the deployment of quarantine, curfew, and roadblocks, all strategies that aim to identify and immobilize suspect individuals (see for example Bonwitt et al. 2018). Shadow zones could only be dispelled through disaggregation, rogue areas brought back 'on the grid' by tracing contacts back to the discrete households where they originated.

The effectiveness of these efforts to control the outbreak is unclear. What is certain is that some measures fuelled distrust and reticence and may have had the effect of driving infections further underground, thus prolonging the epidemic (Bardosh, Leach, and Wilkinson 2016). More pointedly, there is convincing evidence of the important role played by community-led initiatives in curtailing contagion (see for example Richards 2016). While devolving disease control to those suspicious of biosafety measures may seem counterintuitive, the surveillance, isolation, and reporting mechanisms gained both accountability and enumerative power when they were anchored by the practical experience and social intelligence of community-level institutions (Abramowitz et al. 2015).

Andrew Lakoff (2010) has argued that global health attention operates through bifocal optics. The diseases to emerge from poor populations are addressed within a framework of biosecurity: they are threats demanding rapid detection and containment. The present suffering of individuals, on the other hand, is addressed through the paradigm of humanitarian biomedicine, concerned first and foremost with the sanctity of life. For the Ebola outbreak response, the 'shadow zones' came to represent those inconvenient forms of social agency that exist between national sovereignty and bare humanity: a kind of social static disrupting the desired immediacy of surveillance. But understanding 'at-risk' populations as a barrier or a site of resistance profoundly understates the resources local communities can offer both to the immediate demands of outbreak control and to the broader goals of global health governance. In his analysis of the obstacles to sociality in an era of globalization, Paul Carter (2013) recounts the failures of the Australian state to make a census of Indigenous peoples. Every effort made by officials to individuate were overwhelmed by the presence of crowds. 'They would not step out of the shadows', Carter (2013, 4) writes, 'because they realized that the solar spotlight of utilitarian enquiry would

not respect the shadows, the chiaroscuro of social forms, regions of care and cobwebbed reciprocities that enabled crowds to act together while remaining apart'. The mob is not always an engine of irrationality; control does not necessarily follow from illumination.

Crepuscular attention

> You can come collect the rats. They are here – the claws were scratching against the metal all night.
>
> – Elderly woman, Sokurula

The methodological bearing of ethnography on zoonotic research and control tends to be understood in terms of situating the epidemiological dynamics of transmission within the social contexts in which infectious contact between and among species occurs. Our task within LAROCS was to map the social morphology of human-rat relations through the lens of the house, including its construction, aesthetics, and functional distribution, and the arrangements of furnishings, objects, and clothes. An apprehension of the vicissitudes of light and darkness demonstrated, first, the profound temporal structure of these domestic landscapes, specifically how the convivial qualities of a room changed depending on the time of day. Second, the transformative effect of nighttime and shadows on how and where rodents and humans relate revealed highly attuned practices of accommodation and avoidance.

These strategies presented a potentially inconvenient corrective to LAROCS' intervention, however. Indeed, while people were generally appreciative of efforts to trap rodents, some doubts were expressed regarding the long-term effectiveness of the project's focused intervention in the face of such a ubiquitous guest. For some, the sound these trapped animals would make at night – a dreadful clawing against metal – simply posed a new set of disturbances, distinct from the noises that residents have learned to ignore.

A richer description of the affective dimensions of encounters between humans and nonhumans is a central advantage of an anthropology of zoonosis. These accounts can provide key insights into the risks of infection and the viability of preventative measures. That being said, the insurmountable logics of outbreak response and containment can make it difficult to render these nuances of understanding actionable. A focus on light has granted us some conceptual latitude to critically reflect on those epistemic disjunctures, both the mismatch between the lived experiences of infectious disease risk as told from the ground up and the demands introduced from the top down by the need to respond rapidly to an outbreak. Our aim, then, is not only to shed new light, as it were, on how luminosity and

darkness shape the contexts of viral amplification but also to take seriously the conceptual reification of light as enlightenment within the fields of global health research, policy, and intervention. Ultimately, examining the rhetorical and material agencies of light and darkness symmetrically may help refine some of the maladroit framings of zoonotic risk, infection, and contagion.

In *The Parasite*, Michel Serres (1982) makes a series of conceptual forays into the 'dark side of the system': the noise, indeterminacies, and interferences that create the conditions for communication. He likens the philosophical commitment to clear and distinct ideas to life on the moon: 'Without any atmosphere, where a screen separates space into black and white, furnace and glacier, blinding light and opaque night' (Serres 1982, 69). Down on earth, 'the air, the milieu, (the medium), make light diffuse; it outlines obstacles, lights the other side of walls, single-point light sources producing scallops and patterns' (Serres 1982, 70). The household is an exquisite example of how atmospheres vivify – socially and pathologically – space, and of how the sensible and sensate dimensions of life are filtered and flattened through conceptualization. The domestic, perhaps most lively at its invisible edges, implies not clarification but a thinking through shadows, if we want to capture ethnographically the tensions between coexistence and separation.

Infectious disease control is, of course, a matter of surfaces, of determining and interrupting the chain of contacts that precipitate and amplify contagion. Yet work in virology teaches us that surfaces have depth; textures, tempos, and temperatures can precipitate viral decay or stability. Zoonoses unfold across this convoluted milieu, in the borderlines of invisible and visible worlds, where complex agencies persist and proliferate. An anthropology of light and zoonosis is an invitation to peer into the penumbra cast by global health interventions.

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