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Avian preparedness: simulations of bird diseases and reverse scenarios of extinction in Hong Kong, Taiwan, and Singapore

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This article describes relations between humans, animals, artefacts, and pathogens in simulations of disasters, taking bird diseases in three Chinese sentinel posts as ethnographic cases. Drawing on distinctions between simulation, ritual, and play, it shows that the engagement of actors in the imaginary of simulations, which they describe as 'realism', reflectively reverses the oppositions between humans and nonhumans, active and passive, fiction and reality that shape ordinary life. Borrowing from the anthropology of hunting societies, it argues that simulations of bird diseases, considered as signs of future species extinction, rely on cynegetic techniques of power, in which humans and animals symmetrically shift perspectives, and not only on pastoralist techniques, in which humans are above the population they monitor and sometimes sacrifice.

Introduction: techniques of preparedness and human/animal relationships

In the last twenty years, techniques of simulation have multiplied in the world of disaster management (Revet 2013). The stated objective of these exercises is to 'rehearse' a disaster situation in order to better prepare for it (Armstrong 2012). Actors in a simulation treat the expected disaster as if it had happened in order to immerse themselves in the reality it should produce (Seligman, Weller, Puett & Simon 2008). As such, simulations offer opportunities for social anthropology to combine science and technology studies with the ethnography of rituals. Enacting the imaginary of coming catastrophes, simulation creates an extraordinary setting for performances separated from ordinary life.

Two kinds of simulation can be distinguished: desktop (or table-top) exercises, relying on computer programs and occurring indoors, and real-ground (or full-scale) drills, involving actors in an outdoor setting. Both techniques use worst-case scenarios, written by disaster-management professionals trained in fiction writing. If simulation is a regular activity for scientists working on computers, it also shapes the stage of extraordinary performances for ordinary citizens involved in drills (Sismondo 1999). However, the distinction between these two forms of simulation is not between reality and fiction, since those who write scenarios for these two kinds of simulation constantly play on the shift between virtual and actual. They rely on the memory of previous catastrophes and the anticipation of future disasters to inform a realistic engagement in the present of the simulation. If scenarios are considered as shared forms or schemes

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of action, simulations can be described as ritual performances displaying relations between humans and nonhumans in extraordinary settings.

This article starts from observed simulations of an avian influenza pandemic in China. Influenza viruses emerging from birds have been considered as potentially causing future pandemics, because birds (particularly waterfowl in south China) have been identified as the reservoir in which flu viruses mutate before spreading successfully between humans (Shortridge & Stuart-Harris 1982). Among other techniques such as early warning systems and stockpiling vaccines, preparing for the next pandemics therefore involves simulating the transmission of pathogens from birds to humans (Caduff 2015; Lakoff 2007). Arguing that a human pandemic is a symmetrical threat to the extinction of a bird species, I then consider another bird disease for which Chinese experts organize simulations: botulism. This disease, which doesn't affect humans, is considered a potential disaster for black-faced spoonbills because it kills migratory birds when they concentrate in wetlands on their flyways (Wilson 2010: 76).

Bringing together simulations of avian influenza and botulism, this article questions the ethnography of simulation from the perspective of animal studies. How does preparedness transform relations between humans and birds? What does it mean to include birds, and more generally animals, in exercises simulating coming disasters? How does the description of animals as victims of disasters transform them into actors of simulations (Keck & Ticktin 2015)? I will show that animals become, in a paradoxical way, 'passive actors' when they carry the signs of diseases that can potentially affect humans.

Techniques of preparedness have been included in the set of tools for global health initiatives, either in humanitarian actions or in biosecurity interventions, which have shaped contemporary affects and anticipations of the future (Adams, Murphy & Clarke 2009; Lakoff 2010). Global health has been extended to animals and the environment – an approach called 'One World, One Health' – thus requiring an interspecies approach towards the ethical issues involved (Hinchliffe 2015). One of the most debated questions in the anthropology of pandemic preparedness is the adequacy of the notion of sacrifice to describe how some populations are separated from others and killed or left to die for the sake of public health. In exercises of triage, some patients are prioritized over others through the framework of urgency (Nguyen 2010; Redfield 2013). In the management of human populations, migrant workers are considered as a threat by educated experts using viral connectivity as a metaphor of modernity (MacPhail 2014; Mason 2016). In the management of zoonotic pathogens, the notion of sacrifice seems even more obvious, since animals are massively killed to eradicate the reservoir of emerging infectious diseases; and in the management of wild animals, some individuals are sacrificed to protect the species (Van Dooren 2014). Other descriptions, however, have been proposed of the entangled relations between animals and humans in the 'hotspots' or 'sentinel devices' where emerging pathogens connect them in productive ways (Brown & Kelly 2014; Fearnley 2015; Keck & Lakoff 2013; Lezaun & Porter 2015; Lowe 2010). While sacrifice separates some living beings from others to eradicate pathogens, sentinels instantiate relations between living beings through the anticipation of future pathogens.

Simulations of bird diseases shift perspectives between humans and animals through the use of fiction. To support this argument, I rely on the anthropology of hunting societies, by contrast with pastoral societies. While public health relies on pastoral techniques of power combining sacrifice and surveillance to contain the threats coming from outside in a population (Foucault 1981), the 'One World, One Health' approach uses techniques from birdwatchers and wildlife managers to monitor data about changing relations between humans and animals.[1] Whereas pastoral techniques are asymmetrical, relying on the pastor's superior gaze over the flock manifested by sacrifice, cynegetic techniques are symmetrical, as hunters and prey constantly change perspectives when displayed in rituals (Chamayou 2012).

Most analyses of simulation have placed it in a genealogy starting with the Cold War, using notions of ritual, performance, and play (Davis 2007; Galison 1997; Gusterson 1996; Lakoff 2007; Masco 2006). But they don't take the perspective of animals because they consider simulations as pastoral techniques of biopower, therefore bypassing what the anthropology of hunting societies shows about ritual action. In this article, I define a cynegetic practice of simulation that is always mixed with forms of planning, combining two different forms of anticipation. I call 'avian preparedness' this mix of cynegetic becoming-animal and pastoralist care for populations initiated by microbiologists, considered both as 'virus hunters' (Perrey 2012) and as 'microbe farmers' (Caduff 2015: 76).

To analyse simulations of bird diseases, I combine the notion of reverse scenario (Schull 2015) with the notion of reflexive ritual. Pandemic or extinction scenarios, I argue, connect humans and animals in realistic ways to play on the imagination of what could happen if a pathogen emerges. Using animal reservoirs as mirrors in which anxieties about pandemics are reflected, humans exchange their perspectives with animals in an imagined future where their relations are reversed. Simulations can thus be situated in an anthropological space between play and ritual. Roberte Hamayon (2015: 97) has called 'simulation' the way shamans in Mongolian hunting societies imitate the movements of animals in a ritualized setting to prepare for the uncertainties of hunting. In an article entitled 'Dissimulation and simulation as forms of religious reflexivity', Michael Houseman proposes to move away from a definition of ritual as a collective action based on a shared secret to study 'the emergent properties of ritual simulation generally' (2002: 77). He draws on two cases taken from hunting societies of Central Africa, one in which male novices are symbolically killed and the other in which a goat is actually sacrificed. He asks: how do participants come to believe in a series of speeches and actions – the novice's death and the goat's consent to sacrifice – that are obviously false? He answers that ritual action creates an extraordinary space of reflexivity with regard to the ordinary relations that constitute the group. While the ritual for male novices is a 'dissimulation', in which the relations between initiated and uninitiated are constantly reversed in such a way that the moment of death becomes uncertain, the ritual of goat sacrifice, says Houseman, is a simulation of consent, in which the silencing of the goat through the consumption of herbs mimics the consent of male hunters to their initiation. The ritual is reflexive in the sense that it stages the condition of the ritual itself – the secrecy known by initiators and unknown by the initiated – through the manipulations of daily relations between humans and nonhumans, whose asymmetries are reflected as in a mirror.

Similarly, I suggest that we call 'reverse scenarios' the ritual performances by which simulators reflect playfully on the relations between humans and birds in the imagination of a disease that could affect them both. Simulations, I argue, are far more than mere 'rehearsals' of a pandemic drama: they are catalysts in the transformation of human/nonhuman relations into asymmetrical biopolitical and ontological processes.

To support this argument, I will describe three ethnographic cases in Hong Kong, Taiwan, and Singapore. These three territories have competed at the global level since the SARS crisis in 2003 to be the best 'sentinel posts' where pandemic pathogens coming from China can be detected (Abraham 2007). As hubs for the intense circulation of persons and commodities in Asia, but also as repositories of Chinese traditional relations between humans and birds, they have prepared for the catastrophic effects of a bird flu outbreak. But while the Hong Kong government regularly culls its poultry and sends warning signals from the Chinese border, Taiwan and Singapore rarely had to cull their poultry and rather invested in scenarios for the simulation of pandemic. Taiwan, on the other side, shares with Hong Kong the monitoring of black-faced spoonbills, considered as one of Asia's most threatened and charismatic species.

This article thus connects the rationalities of preparedness with the economies of human/animal relations in three different but interconnected settings. It will examine indoor and outdoor simulations of avian influenza in Singapore and Hong Kong, and compare them with simulations of botulism in Taiwan. However, my analysis is not restricted to simulations of bird diseases in East Asia, but highlights general traits of disaster simulation as a technique of preparedness. By looking at the relations between humans and birds in these three contexts through their common exposure to emerging pathogens, this article also analyses the relations between national states in Asia as they have to manage a common disaster. Since simulations of bird diseases connect relations at different scales, from the microbiological to the biopolitical, this article combines science studies, ethnography of rituals, and political economy through an anthropology of 'more-than-human' relations (Helmreich & Kirksey 2010; Kohn 2013; Sagan 2011).

Desktop exercises and reverse scenarios

In July 2013, I was visiting Gavin Smith, who was then an Associate Professor at the Duke Graduate Medical School of the National University of Singapore (NUS). I had known Gavin in Hong Kong while he was working in the State Key Laboratory of Emerging Infectious Diseases at the Department of Microbiology of the University of Hong Kong. Born in Australia, Gavin had studied botany and ecology at the University of Melbourne, and then moved to Hong Kong for a Ph.D. in molecular systematics. Gavin had first analysed the genome of fungi, then of the SARS coronavirus, then of bird flu viruses. He described this development of his research as a reduction of the size of the living beings he was sequencing, and a refinement of the data and results he could produce.

Gavin and his team relied strongly on the collaboration between the State Key Laboratory of Emerging Infectious Diseases and the University of Shantou. This university had been created by the Hong Kong tycoon Li Ka-Shing, who opened it in 1990 in his native Guangdong, with the approval and administrative support of the Chinese authorities. It provided the State Key Laboratory of Emerging Infectious Diseases with samples collected in poultry markets in Fujian province, thus offering a real-time surveillance of influenza strains emerging in this 'epicentre' of pandemic flu. But after the publications of Gavin's team showed the role of the Chinese poultry industry in the emergence of these new strains (Smith *et al.* 2006), the Guangdong authorities had severely restricted Hong Kong virologists' access to these samples. Gavin then moved to Singapore in 2012, where he had more freedom to continue his fundamental research, and more funding from international institutions. He had shifted from the sentinel post, where the new strains of avian influenza emerged, such as the

H5N1 virus in 1997 (Keck 2010), to a place where he could simulate the evolution of flu viruses in high-tech computers. There was no need to be close to the site where viruses emerge, he explained to me, as he could simulate viral emergence through the use of genetic data banks.

Singapore was then considered the new 'pole of excellence' for biological research. The small city-state founded by Lee Kwan Yew in 1965 at the end of the Malay Peninsula had converted its industrial and financial power, owing to its position on the commercial trade routes between East and West, into an economy of knowledge and information, with high investment in biotechnologies (Ong 2010; 2016). The NUS Graduate Medical School was located just next to the Ministry of Health and the Singapore General Hospital, in the centre of the city. It had been created in 2005 to train high-tech medical leaders on the model of the Duke University School of Medicine in North Carolina. The Programme in Emerging Infectious Diseases, for which Gavin had been hired to work, was headed by Wang Linfa, who was also leading a team on bat viruses at the Australian Animal Health Laboratory in Geelong. His programme was running projects for the surveillance of emerging infectious diseases, particularly influenza and other respiratory diseases, in Singapore and the rest of Southeast Asia.

Gavin's career took a meaningful turn when his team published two major articles at the height of the 2009 H1N1 pandemic. The first one, entitled 'Dating the emergence of pandemic influenza viruses', was published just after the emergence of the H1N1 virus in Mexico in April 2009. It showed that genetic components of the 1918 H1N1 pandemic virus circulated among pigs and humans as early as 1911, thus challenging the commonly held view that Spanish flu jumped from birds to humans in 1918. In the context of the new H1N1 'swine flu', this article stressed the need for intensified surveillance of pigs to detect emerging flu viruses before they become pandemic. 'If future pandemics arise in this manner', Gavin and his team concluded, 'this interval may provide the best opportunity for health authorities to intervene to mitigate the effects of a pandemic or even to abort its emergence' (Smith, Bahl, Vijaykrishna, *et al.* 2009: 11712).

This conclusion was immediately reinforced by Gavin's team's second publication, entitled 'Origins and evolutionary genomics of the 2009 swine-origin H1N1 influenza A epidemic', published in *Nature* at the end of 2009, in which they showed that a 'twin' virus bearing the same genetic sequence as the pandemic H1N1 had been identified in pigs in Hong Kong in 2004. Gavin's conclusion was not that the Asian swine industry was to blame for the emergence of H1N1, but that there was a better surveillance of the animal reservoir for influenza viruses (waterfowl and pigs) in Hong Kong than in the United States. The team's paper ended, 'Despite widespread influenza surveillance in humans, the lack of systematic swine surveillance allowed for the undetected persistence and evolution of this potentially pandemic strain for many years' (Smith, Vijaykrishna, Bahl, *et al.* 2009: 1125).

In July 2009, I took a course at the Hong Kong University Pasteur Research Centre in bioinformatics, during which Gavin and his team partners, Vijay and Justin, explained to virology students how to obtain this kind of result. Bioinformatics is a method to analyse the massive amount of biological data available on the web – particularly through the website of the US National Center for Biotechnology Information, Genbank – with the help of dedicated software. This software, called BLAST (Basic Local Alignment Search Tool) or MSA (Multiple Sequence Analysis), calculates the probability that genetic sequences derive from one another. Such a procedure, called alignment, aims at approximating the real descent relationships between viruses through a calculation of the optimal 'tree of life', based on the Darwinian hypothesis that life expands in a rational manner to maximize fitness capacities (Mackenzie 2003).

For Gavin and his team, however, bioinformatics was not only about probability calculation. In the construction of a phylogenetic tree, biological knowledge is necessary because some correlations proposed by the computer make no sense in an evolutionary perspective, as they can be due to errors in sequencing or genetic deletion. To decide which correlations to take into account and which to consider as irrelevant, virologists use other software (such as Bootstrap, Jukes Cantor, or Tamura) providing the probability of correlations based on a given scenario. As for other techniques of preparedness, probability is not enough to simulate a coming disaster: it requires a work of imagination (Lakoff 2007). Peter Galison has shown that computer simulation emerged in the field of particle physics as a 'subculture' among experimenters and theoreticians under the 'Monte Carlo' programme funded by NASA in the 1960s to simulate a nuclear explosion. Simulation replaces experimentation when the data needed for the theory are too numerous and complex to be processed with traditional instruments, creating a 'trading zone' in which different professional groups share a common language or 'pidgin' (Galison 1997: 50). Similarly, bioinformatics produces new images shared by microbiologists, computer scientists, and public health executives in the anticipation of epidemics. Software such as Bootstrap can be considered as an accessory or decoy to trap the live bird viruses through the sequences that have been stored in Genbank.

Gavin opened the course with a simulation of the work his team had done a few months before on the H1N1 virus, presented as a desktop exercise of what to do when a new virus emerges. 'Imagine we've received this new sequence from Atlanta. Paste it to BLAST, and take as much information as possible. Make a tree so big you can never print it on a sheet of paper: it will be good starting material before reducing the inquiry'. Gavin and his team explained that in contrast to other virologists working on flu viruses, they had decided to use the eight segments of the virus's RNA,[2] not just the two segments that shape the H and N proteins, usually considered to be the most significant markers of antigen evolution. They could thus build eight parallel evolutionary trees which, by their similarities, gave an indication of the real evolution of the whole flu virus. There was nothing secret in the images of pandemic viruses built by these microbiologists, unlike simulations of nuclear explosions built indoors by particle physicists (Gusterson 1996): all the phylogenetic trees produced by Gavin and his team were publicly available on websites.

Drawing back the 'molecular clock' based on the estimated kinship relations between viruses, virologists could see the branches where evolutionary ruptures occur and pathogens jump from one species to another, such as the emergence of the H1N1 pandemic in 1918 and 2009. Following continuities between genetic sequences, they exhibited the discontinuities between evolutionary niches. Gavin said that when a virus jumps from one species to another, it inaugurates a new set of lines, as the 'immunity pressure' of the environment creates an 'evolutionary bottleneck' in which this mutation can replicate. Drawing back these lines then lead him to what he named 'The Most Recent Common Ancestor'. 'I love those trees', he added. The amount of information provided in a single image was correlated to the unity of an evolutionary hypothesis drawing this information back to a common ancestor.

Historians of science have shown the power of evolutionary trees in the books through which Darwinism came to be accepted as a new worldview (Bredekamp 2005;

Helmreich 2009), and their reframing in global health under the notion of an animal reservoir in which emerging pathogens spill over from animals to humans (King 2002; Lynteris 2017). But I was mostly intrigued by the way Gavin and his team turned sequences into images through an anticipatory mode of reasoning that I call 'reverse scenario'. Natasha Schull proposes the term in her work with on-line gamblers, to describe the way they 'cope with the necessarily uncertain futures of any hand by returning them to a point in the past and confronting them with a branching diversity of outcomes that might have emerged from it' (2015: 56). It applies well to the practices of 'virus hunters' who use 'reverse engineering' to reconstruct potentially pandemic pathogens such as the 1918 H1N1 virus (Caduff 2015: 105; Napier 2003: 2). Just as a gambler speculates how much he could have won if he had played this or that card, Gavin imagines what could have happened if the H1N1 virus had been detected in pigs prior to 1918 or 2009. Virus sequencing allows him to trace potential connections between birds, pigs, and humans, and to imagine other futures of cross-species transmission. Yet we don't know how birds (and pigs) are actually involved in the construction of pandemic scenarios, because we don't see how virologists take virus samples from birds. We thus need to turn from desktop simulations to 'real-ground' exercises organized by public health officials and birdwatchers.

Real-ground exercises and realistic scenarios

After my visit to Gavin Smith at NUS Duke Graduate Medical School, I went to a nearby building to meet Jeffery Cutter at the Singapore Ministry of Health. Trained as an epidemiologist, Jeffery Cutter was the Director of the Communicable Diseases division of the Ministry of Health, co-ordinating preparedness for emerging infectious diseases in Singapore. 'There are 50 million passengers every year at Singapore Changi Airport', he told me, 'so there is a high probability that emerging infectious diseases will come to Singapore. We need to be prepared'. During the SARS crisis in 2003, he said, 238 people were infected by the new coronavirus, with thirty-three deaths. They were all treated at the Tan Tock Seng Hospital, which had been designated by the government as an isolation hospital for SARS patients. At the peak of the crisis, all schools in the country were closed for ten days, and home quarantine was established for more than 6,000 people known to have come into close contact with a SARS-infected person. Prime Minister Goh Chok Tong said publicly that SARS could possibly become the worst crisis Singapore had faced since independence. When a journalist asked him if he was being alarmist, Goh responded: 'Well, I think I'm being realistic because we do not quite know how this will develop. This is a global problem and we are at the early stage of the disease' (Zolli 2012).

Jeffery Cutter introduced me to Yoong Cheong Wong, head of the Emergency Preparedness & Response Division at the Ministry of Health. Mr Wong was a former policeman in charge of organizing exercises for emerging infectious diseases in hospitals. The first national exercise for influenza in Singapore was organized in 2006, after the first cases of human-to-human transmission of H5N1 were suspected in Thailand. Called 'Sparrowhawk', it was organized in two stages: a table-top discussion and assessment of pandemic response plans among six hospitals in the country between April and June; and a practical exercise on 21-2 July, in which the six designated hospitals had to manage potential patients and share information about their circulation. Mr Wong explained that a thousand people were involved in the real-ground drill, mostly volunteers from grassroots organizations and nurses from training institutions. While patients moved from one hospital to another, some hospitals assessed the behaviour of others and gradually raised the number of casualties. The main question, according to Mr Wong, was: 'If there are 200 casualties in one hospital, which resources do they need?'

The goal of these exercises is officially the identification of unplanned gaps in co-ordination between the actors who manage epidemics. But the actual criticism of planners most often focuses on the drills' lack of realism. 'We try our best to do it as real as possible', said Mr Wong, 'but everyone knew it was just an exercise'. To explain the improvement between 'Sparrowhawk' exercises in 2006 and 2008 in Singapore, an official leaflet notes, 'The exercises were activated unannounced to inject greater realism. The Ministry of Health Emergency Medical Staff turned up without prior justification at the general ward of the exercise hospital and "triggered" the simulated case of human infection with avian influenza' (UNSIC 2008: 56). Realism, in this case, came from the fact that people were surprised, and yet they knew that they were faking the epidemic.

What does it mean for a simulation to be realistic? Here the notion of 'reverse scenario' is useful. Just as microbiologists imagine what could have happened if viruses had been stopped in their animal reservoir, public health planners imagine what would happen if contagious patients were stopped before entering hospitals. But in both cases, death is not performed in the scenario. By contrast, another type of exercise conducted in Singapore was very real. On 17 July 2013, the Agriculture and Veterinary Authority (AVA) organized a drill in one of the poultry slaughterhouses on the border with Malaysia. There are no authorized poultry farms on the territory and only five chicken farms for eggs, which constrains Singapore to import and slaughter 40 million live chickens from Malaysia every year. Malaysian farmers need to be licensed by the AVA to import their poultry to Singapore, and are always regarded with suspicion by border authorities. And yet no case of H5N1 has been found in Singapore.

I was able to watch the drill on-line because it was streamed widely on a number of websites. The name, 'Exercise Gallus VII', referred to the fact that it was the seventh avian influenza exercise conducted by the AVA since 2002. It took place in the biggest of the ten slaughterhouses in Singapore run by Soonly Food Processing Industry, which processed 80,000 chickens daily, providing 25 per cent of the fresh chicken meat in Singapore (*Asia One* 2013). The scenario for the exercise was the following: 1,500 chickens had been infected with H5N1 and should be killed and destroyed, according to emergency response plans. About 100 employees of the slaughterhouse, mostly Indians, had to be screened for their temperature, take an antiviral drug, and then wear personal protective equipment (boots, cap, mask, glasses, gloves) on the back of which their name was written. The 'affected' chickens were placed in green cages on belts, immersed in water, and electrocuted. Their cadavers were then placed inside two layers of biohazard bags to be incinerated. Dr Yap Him Ho, Director of the Quarantine and Inspection Group, declared on television, 'To make sure that AVA is prepared for any incursion, the main thing we want to do for this exercise is to train our officers, as well as the other parties that are involved in the contingency planning, to be familiar with the steps of the procedures' (*Straits Times* 2013).

Although much could be said on the paternalistic ethnic, gender, class, and age divides that structured these exercises, I want to focus on the distinction between humans and animals. While the simulation at the clinic was animated by a sense of urgency and scarcity of resources confronted with a fake pandemic, the simulation at the slaughterhouse was quietly following the procedures in actually killing false positive chickens. I was also intrigued by the fact that while the Hong Kong government organized many such exercises on the human side, they had never simulated bird flu in poultry farms, because outbreaks occurred regularly in farms on its territory. While Singapore authorities actually killed poultry for a disease that remained virtual, Hong Kong authorities simulated the transmission of bird flu from chickens to humans because it was already circulating among birds. Although avian influenza kills birds as well as humans, the reverse scenario of a pandemic represents massive death in a different mode for humans and for birds, depending on past experiences of pathogens crossing borders between species.

I now turn to the simulation of bird flu in Hong Kong. On 13 November 2006, Hong Kong co-ordinated a desktop exercise called 'Great Wall' which simulated a virtual cluster of three human infections with H5N1 in a family returning to Hong Kong and Macau after their visit to a poultry market in mainland China. The goal of the exercise was 'to synchronize the three systems of pandemic preparedness to engender an effective response among them' (UNSIC 2008: 18). The exercise opened with a ceremony attended by the Vice-Minister of the Chinese Ministry of Health, Wang Longde. It was considered as a success in creating good relations between mainland China and the former British and Portuguese colonies. While the SARS coronavirus had caused a division between China and the former colonies in 2003 because of Beijing's reluctance to share information (Abraham 2007), 'Great Wall' unified the country against an imagined enemy, pandemic avian influenza, but it instantiated ruptures between humans and birds.

In January 2009, after long discussions with the Centre for Health Protection, I was allowed to participate in an exercise in a Hong Kong hospital. The Centre for Health Protection was created by the Department of Health after the SARS crisis to anticipate outbreaks similar to SARS through active surveillance and communication (Leung & Bacon-Shone 2006). Within this Centre, the Emergency Response Branch, headed by a police officer, was in charge of writing scenarios and organizing simulations. Twice a year, a field exercise was held in Hong Kong, with observers from China and overseas, bearing the name of natural entities: Maple, Cypress, Chestnut, Redwood, Eagle, Jadeite, and so on. There was no epidemic simulation in Hong Kong in 2009 because the Emergency Response Branch considered the management of the H1N1 virus in the spring and autumn to be a 'real-life exercise'.

'Exercise Redwood' took place in the clinic of Shau Kei Wan, located in the working-class district of Hong Kong island. The following scenario was distributed to the participants and posted at major public buildings. Confirmed human cases of bird flu had been reported in Hong Kong's neighbouring countries, as well as a rising trend in patient attendance with influenza-like illness in Hong Kong hospitals. Live poultry had tested positive for avian influenza in Hong Kong's markets and were then culled at farms and markets. A member of the staff participating in the culling was reported to carry the H5N1 virus, as was an 8-year-old boy who had played with live poultry. Four clinics were designated in Hong Kong for triage. Only the final part of the scenario was held in Shau Kei Wan; the first part was meant to provide a plausible context.

The official purpose of the simulation was to co-ordinate hospital services in the management of patients with influenza-like illness. Eighty actors playing patients came in through the front door of the hospital and were sent to different departments depending on their symptoms (pulmonary conditions, tuberculosis, etc.). Twenty 'players' treated them in the services, and two 'simulators' communicated with other hospitals on a hotline. Those who were diagnosed with H5N1 were evacuated by ambulance through the back door of the hospital, where the media took pictures. The head of the Department of Health gave a press conference after visiting the hospital, but the journalists asked him about new bacteria found in a private jacuzzi, not about the exercise itself. The drill's success was not questioned; it was successful because it had been held. The scenario was designed in such a way that no surprising event could happen: the only reality that came up was the bacteria in the jacuzzi, not the virus in bird markets.

All the actors I saw looked young and relaxed, wearing blue caps and casual clothes. Their symptoms were described on a tag they wore around their necks, indicating their name, address, nationality, sex, and age. These cards were red or green depending on whether they had bird flu or only influenza-like symptoms. They did not have to fake illness; their only role was to move to the designated departments. In another exercise organized by the Centre for Health Protection, a plane was evacuated because a patient had been found with influenza-like symptoms; those who sat next to the patient received a red tag, and those who sat at a good distance received a yellow tag. What was remarkable in 'Exercise Redwood' was the absence of tension or anxiety in the medical staff's behaviour. Although humanitarian NGOs consider triage to be an ethical issue when a higher number of patients is met with limited resources (Nguyen 2010; Redfield 2013), the medical staff of the Shau Kei Wan clinic only separated symptomatic and asymptomatic patients to avoid the spread of the disease. The tension of the situation – who would be considered a spreader, who would receive treatment first – was delegated to objects: tags and caps. People were reduced to bearers of signs that circulated fluidly in the hospital under the gaze of the media.

While the medical staff of the hospital played their own role, the actors playing patients with influenza-like illness came from a humanitarian association, the Auxiliary Medical Service (AMS). This association, created in 1950 to deal with the influx of Chinese refugees, was registered in 1983 under the Security Department of the Hong Kong government. Its 4,000 members are trained for disaster management in Hong Kong and outside. One of them described it to me as 'after-work entertainment', 'a place to meet other singles'; it is an elite association where similar people express and share moral values. During their own exercises, performed every month, they train how to rescue victims of car accidents or fires. They simulate heartbeats on dummies with fake hearts. 'Patients cannot fake the heart rate or the respiratory rhythm', said the organizer, 'so they have tags'. Tags have an indirect realistic effect, while dummies can actually simulate the heartbeat of an injured victim.

Members of the AMS, who describe their own exercises as significant moments in the life of the association, were frustrated by 'Exercise Redwood'. From their perspective, there is a sharp difference between regular accident rescue exercises and extraordinary epidemic evacuation drills that co-ordinate several departments. One of the actors said he felt 'passive', playing on the ambivalence of the term:

> As we had experienced SARS in 2003, we all can forecast how we would behave in another similar situation, like avian flu. Being a citizen, we are quite passive; I believe that we should follow the guidelines and the Government's advice so as to prevent ourselves from getting affected. But in the exercise, we were being passive.[3]

It can be said, consequently, that when they simulate patients in an epidemic exercise, members of the AMS literally act as if they were dummies. There is thus a fundamental distinction in the real-ground exercises between actors and players. While actors are passive, reduced to the objects that 'act' or 'speak for them', players and simulators introduce uncertainty by the way they combine these objects in the scenario. If actors have to appear 'real' to produce good images in the media, the simulators play on the fictional possibilities of the scenario. The distinction between simulators and actors in real-ground simulations runs parallel to the distinction between virologists and public health planners in desktop exercises: while actors and planners only follow their roles in the exercise, simulators and virologists explore the potentialities of reverse scenarios.

Another example shows how real-ground exercises combine the virtual and the actual as desktop simulation does. In an exercise called 'Jadeite', organized in January 2007, members of the Emergency Response Branch were simulating the evacuation of a residential building on computers, and the scenario specified that they had to evacuate the simulation room to a 'fallback room'. The simulation room, from which the vulnerability of vital infrastructures in Hong Kong was virtually assessed, thus came to be seen itself as a material environment under threat. The head of the Emergency Response Branch who described this exercise to me said it was 'more fun than a movie', as if images had suddenly burst through the screen. In this reversal of the scenario, simulators became actors, and fiction reality. Neither a ritual performance nor a scientific model of prediction, the simulation was, for this former policeman, a game he enjoyed playing.

Animals take part in simulations in a general category that can be called 'passive actors'. If there was no need to simulate the culling of poultry because it regularly happened in Hong Kong markets, simulators for the evacuation of residential buildings in Hong Kong planned that some residents were accompanied by pets that should be handled with care by the Agriculture Department, because their reaction to the evacuation was unknown, just as simulators of the evacuation of planes planned how to handle 'reluctant potential patients'. The real opposition in simulations is thus not between humans and animals but between poultry, handled as commodities that can be destroyed, ordinary citizens and pets, considered as 'passive actors' that should be handled with care, and simulators, changing the rules of the game. More than sharp ontological distinctions between fiction and reality or between animals and humans, there is a virtual gradient of actors in the anticipation of massive death produced by simulation.

The use of accessories and animals in simulations of disasters is indeed an essential part of their 'realism'. Tracy Davis has shown that people coming from the world of theatre were hired by Cold War experts to implement scenarios of nuclear blast through the design of accessories. Simulation designers were, therefore, less concerned with the participation of the public than with the realism of the objects. After an exercise organized in Coventry in 1954, Prime Minister Winston Churchill complained about the high degree of realism of the simulations, which he considered a waste of public money. 'Who thought of the blood-stained old woman with the birdcage? I hope there is not going to be any more of this sort of thing at Government expense' (quoted in Davis 2007: 51). Women were the main targets of civil defence after the Second World War, as they had been the targets of public health campaigns against microbes at the beginning of the twentieth century, because they were in charge of the household with children and pets. Animals were portrayed as good accessories of nuclear blast simulations not only because they were good laboratory models (Masco 2006: 305), but also because they were part of a familiar landscape disrupted by an extraordinary event.

The extraordinary context of the simulation thus provides the opportunity to display a series of apparent contradictions: people become objects; animals become people; actors turn out to be passive; fiction enters into reality. This capacity to displace oppositions in an extraordinary context through reverse scenarios brings simulations close to rituals. However, if simulations can be considered as rituals of public health administration, justifying the work of virus hunters who sound the alarm about future pandemics, it doesn't mean that there is a secret worldview shared by simulators (Gusterson 1996). Rather, simulations display openly contradictions that public health administrations have to solve, often by the use of sacrifice in operations of culling (of infected poultry) or triage (of suspected patients). They create a tension between two techniques of power: those of biologists and simulators who follow viruses as they mutate between species, which I describe as cynegetic, and those of public health officials who have to protect some populations against others, which I call pastoral. To support this hypothesis, I will now turn to simulations organized by birdwatchers. Can we say that birdwatchers take the perspectives of threatened wild birds as virologists take the perspective of poultry infected with flu viruses? How do humans in charge of the protection of animals cope with the oppositions we have seen in reverse scenarios of pandemics?

Birdwatching exercises and extinction scenarios

Birdwatchers have been involved in the surveillance of the avian reservoir of influenza viruses. Public health and agriculture authorities realized that they could not follow the mutations of flu viruses in wild birds, and collaborated with birdwatching associations to monitor potential cases in wild bird reserves and natural environments. In Hong Kong and Taiwan, birdwatching practices, a privilege of British and American expatriates until the 1980s, have become popular among Chinese middle classes with the development of a leisure society, the commercialization of camera equipment, and the awareness of the vulnerability of the environment (Choy 2011). Birdwatching has taken the form of a 'citizen science' with the opening of websites where amateurs post their observations and experts turn them into statistical data. Every year, bird races offer opportunities for birdwatchers to compete in observing the highest number of birds on a designated territory. Thus, birdwatching practices, like simulations, have virtual and actual aspects, orientated by the imagination of a disaster: the extinction of bird species.

In Hong Kong and Taiwan, the introduction of birdwatching was linked to techniques of preparedness and concerns for biosecurity. The main wild bird reserve in Hong Kong, Mai Po, is situated on the estuary of the Pearl River Delta and on the border with mainland China. After 1949, British officers used to sit there with their binoculars to trace Chinese refugees or to signal an attack by the Chinese army, and took this opportunity to inventory the more than 500 bird species in Hong Kong. Hong Kong and Taiwan were part of the Migratory Animal Pathological Survey, a programme of surveillance of pathogens carried by birds (particularly Japanese encephalitis). Through this programme, British and American ornithologists trained Chinese workers to band birds and collect samples. Transforming birds into data and following the evolution of their numbers has been a way to simulate threats coming from birds since the Second World War (Keck 2015).

Methods derived from US wildlife management have changed the perception of birds in the last twenty years in Taiwan and Hong Kong, with the introduction of the concept of the flyway. Species that fly from Japan and Korea to Australia, along what came to be called the East Asian-Australian flyway, have been shown to have declined owing to the urbanization and development of the Chinese coast. Climate change is also supposed to damage the places where wild birds feed and roost on their migratory routes. Among the bird species affected by these changes, one of the most charismatic is the black-faced spoonbill, a waterbird breeding in Japan and Korea in the summer and migrating to south China in the winter. In the 1990s, the number of these birds was estimated to be 2,000, but thanks to the conservation efforts shared by the countries to which they migrate, it increased to 3,000 at the end of the 2000s. Wetlands have been developed in Hong Kong, Taiwan, and Fujian as shelters on their flyways. Images of spoonbills abound in schools, environmental agencies, and natural reserves, often portrayed as funny birds smiling to the public. To understand how reverse scenarios of disasters enter the management of spoonbills in China, we have to go beyond these anthropomorphic images, and look at how they actually perform in simulations.

In the winter of 2002-3, seventy-three black-faced spoonbills were found dead from botulism in Taijiang National Park. The Wild Bird Society of Tainan consequently organized a campaign to vaccinate spoonbills against botulism, and used decoys to train their staff on how to safely handle the birds. Since then, drills have been regularly organized for bird protectors to learn how to manipulate fake spoonbills with caution. These decoys are also used to attract spoonbills for GPS monitoring. Carved in wood and painted in black and white, they are posted in the wetlands close to traps. Decoys are different from images of spoonbills on posters: wildlife managers interact with them as if they were alive, because of their accurate mimicking.

The use of decoys is a traditional feature of bird hunting. By contrast with lures, which attract birds based on their appetites, decoys attribute intentions to prey (Schaeffer 1999: 64). In England, duck decoys take the form of pondside wooden houses into which ducks are attracted by a fake dog, because hunters have observed that ducks swim towards the dog to signal that it has been seen. In the same way, the fake spoonbill is used as a decoy because it creates a situation of communication with the bird. But at the same time, the fake spoonbill is used as a dummy by birders who train to manipulate spoonbills in risky situations, as in epidemic simulations. The use of spoonbill decoys mixes hunting techniques and pastoral techniques because decoys are considered both as intentional agents and as objects that should be manipulated with care.

This hypothesis was confirmed on 29 April 2013 when the Wild Bird Federation of Tainan led me to a site where three black-faced spoonbills had been trapped – a very rare event, which I was considered lucky to have witnessed. Birdwatchers had found shelter in a Taoist temple on the banks of the marshes, and they turned on some Buddhist music to soothe the birds. With very calm gestures, a man equipped with gloves and a mask sewed a GPS satellite tracking device around the waist of the spoonbill, while a woman held it gently but firmly. Five other birdwatchers watched them with amusement, taking pictures and making comments on the bird's reactions. The man explained to me that he had to be cautious because it was a young spoonbill, so the weight of the satellite tracking device had to be imposed on its body in such a way that it would not hamper its growth or unbalance its flight. How to build techniques of monitoring that do not kill animals considered as indexes of the fate of their species is a major concern for wildlife managers, who often talk about the sacrifice of individual animals when they die as the result of an improper monitoring device (Benson 2011). But Taiwanese birdwatchers focused the discussion on how to properly release these birds so that they would not be sacrificed but become sentinels of a threatened species.

The release of birds is a major ritual concern in south China, known as *fangsheng* (literally 'let live'). This practice finds its roots in aristocratic practices of opening the cages of birds who sang well, and was codified in Taoist rituals as a specific sequence of releasing a live animal; but it has developed massively in recent centuries with its qualification by Buddhists as a practice of compassion that increases the 'merits' (*gongde*) of those who release live animals (Handlin Smith 1999). In Hong Kong and Taiwan, Buddhist associations entered into discussion with birdwatching societies because many birds were found dead after they were bought in bird markets and released in surrounding natural parks. These associations had to warn through posters that releasing birds could cause the death of birds, because they were released in an improper environment, and the death of humans, since some of the birds found dead after the release carried avian flu (Severinghaus & Chi 1991).

Consequently, when they released a bird equipped with GPS that they had learned to manipulate through the use of decoys, Taiwanese birdwatchers inserted a ritual sequence into a simulation practice. While the ritual introduced the bird into a cycle of life and death, the simulation used the decoy to produce signs of future threats for birds and humans. The black-faced spoonbills were released in the Taijiang National Park with the hope that they would fly over to Hong Kong or the Fujian coast, where their signals could be captured. It should be noted that the Taiwan Straits are also the sites of military exercises or drills through which threats coming from China are mitigated. To prepare for an attack from the People's Republic of China, the Taiwanese Centers for Disease Control was organizing exercises simulating the use of bioweapons in a public space, such as SARS, smallpox, and avian flu virus (Rollet 2010: 311). The release of a black-faced spoonbill in the same Chinese straits mimics and reverses the scenario of an avian flu outbreak from China. Instead of carrying information on the potential war between two long-term enemies, it produces signals on the changes of bird habitats that concern birds as well as humans. While in the public health simulations birds are considered as carriers of infectious diseases, birdwatchers' simulations frame them as living beings with which humans share pathogens as signs of communication.

Another practice with birds in Taiwan clarifies by contrast their role in simulations. According to PETA, more than a million pigeons are released every day from boats in the Taiwan Straits by pigeon-racing clubs, and only 1 per cent survive to come back to their shelter. Huge amounts of money (an estimated US$2 billion) are spent in bets on those which will return, welcomed as heroes if they are first, killed if they are too slow.[4] This is neither a ritual nor a simulation but a gambling practice through which birds crossing the sea between China and Taiwan are qualified as political signifiers. The reverse scenario of the game, producing strange identifications between humans and birds, tells the story of a pigeon successfully returning home while others fail and die in the Taiwan Straits.

Releasing a bird in Taiwan can thus appear as a simulation when it is embedded in the framework of an environmental flyway, as a ritual when it mobilizes a cosmological view of the circulation of souls between humans and animals, or as a game when it is organized on the border separating two competing territories. Simulation, ritual, and play are three frameworks to mitigate the uncertainties of catching and releasing a potentially sick bird.

Conclusion: simulations between games and rituals

I have considered three stages where bird diseases are simulated: computer simulations of avian influenza by microbiologists; outdoor performances of pandemic influenza by public health administrations; and exercises of manipulating threatened birds by birdwatchers. These three types of simulation displace the problem of sacrifice: that is, the definition of those who deserve to live and those who will die. Microbiological surveillance of viruses moves away from the site of emergence where birds are killed to prevent the spread of pathogens to humans, and traces continuities between humans and animals as a reservoir where viruses silently mutate. Simulations of epidemics don't address the problem of triage between humans in a situation of exception, but rather configure new relations between humans and animals through accessories in a performance. Exercises of vaccinating and releasing potentially sick birds don't raise the issue of how many birds can die for the sake of the species, but rather reflect on how to handle a bird with care in a political environment where they carry signals of threat. In the reverse scenarios of simulations, birds appear not as sources of infection that must be eradicated, but as sentinels with which humans can communicate to imagine potential futures.

Simulations, therefore, should be analysed not only as a pastoral technique of power, as ways to mobilize populations under a common threat in which some are sacrificed for the sake of others, but also as a cynegetic technique of power, creating relations of identification between humans and animals around a perceived uncertainty at the borders between species. In the world of databased science and transparency of communication, simulations of bird diseases imply playing like animals or with animals to anticipate the (im)possibility of a mass extinction, thus mobilizing elementary forms of identification.

In the cases I have considered, the question of the realism of exercises is a way to draw attention to the circulation of objects that recast relations between humans and birds by simulating the diseases they share. The use of computer software, accessories, and decoys in the three types of simulations I have analysed blurs the sharp opposition between humans and nonhumans. These objects can be considered as decoys because they carry the intentions that humans attribute to animals and shift their perception from inanimate objects to living beings. While scenarios of bird-generated epidemics play on the asymmetries between humans and birds, the horizon of the simulation (the extinction of the human or of a bird species) integrates them as common actors of a game. Simulations can thus be considered as reflexive rituals because they display the uncertainties of the beings they play with and help to mitigate their threats. Framing simulation as an operation unfolding between the spheres of mimetic play and reflexive ritual, and at the same time performing a series of subject-object reversals, I have argued for the need to approach this key apparatus of preparedness through a lens that allows for the mixing of pastoral and cynegetic techniques.

What I have called in this article 'avian preparedness' takes place in a long history of simulating bird movements, from classical divination by Roman augurs to medieval bird hunting and modern birdwatching. The specificity of contemporary forms of anticipation through sentinels, simulation, or stockpiling is that the distinction between cynegetic techniques of preparedness, taking the perspectives of birds on future threats through imagination and communication, and pastoral techniques of prevention, protecting human or nonhuman populations from external dangers through risk calculation, has become more difficult to make and yet more urgent. This article has argued for such a distinction, while opening the stage for future analyses of simulations as forms of play and ritual.

NOTES

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[1] This approach was launched in 2004 by the Wildlife Conservation Society, and then endorsed by the international organizations for human and animal health (*http://www.oneworldonehealth.org/*, accessed 7 February 2018).

[2] Contrary to other viruses such as smallpox, flu viruses don't have their genetic information encoded in DNA (a double-stranded helix of nucleic acid) but in RNA (a single-stranded ribonucleic acid). This explains why they mutate more randomly.

[3] Anonymous interview by email after a questionnaire sent to the AMS, February 2009.

[4] *http://www.peta.org/action/action-alerts/first-ever-taiwan-raid-police-bust-pigeon-racers/* (accessed 7 February 2018).

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Se préparer aux catastrophes avec les oiseaux. Simulations de maladies aviaires et scénarios inverses d'extinction à Hong Kong, Taiwan et Singapour

Résumé

Cet article décrit les relations entre humains, animaux, artefacts et pathogènes dans les simulations de désastres, en considérant les maladies qui affectent les oiseaux dans trois territoires sentinelles aux frontières de la Chine comme des cas ethnographiques. En s'appuyant sur les distinctions entre la simulation, le ritual et le jeu, il montre que l'engagement des acteurs dans l'imaginaire des simulations, qu'ils décrivent sous le terme de « réalisme », renverse réflexivement les oppositions entre les humains and les non-humains, l'actif et le passif, la fiction et la réalité qui organisent la vie quotidienne. En empruntant les concepts de l'anthropologie des sociétés de chasseurs, il montre que les simulations de maladies aviaires, lorsqu'elles sont perçues comme des signes d'une potentielle extinction d'espèce, recourent à des techniques de pouvoir cynégétiques, dans lesquelles des humains et des animaux échangent symétriquement leurs perspectives, et pas seulement à des techniques pastoralistes, dans lesquelles les humains sont au-dessus de la population qu'ils surveillent et parfois sacrifient.

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