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The hospital and the hospital: Infrastructure, human tissue, labour and the scientific production of relational value

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Abstract

How does science make a home for itself in a public hospital? This paper explores how scientists working in ‘resource poor’ contexts of global health negotiate relationships with their hosts, in this case the doctors, nurses and patients who already inhabit a Provincial Level Hospital. Taking its lead from recent works on science, ethics and development, this paper seeks to ‘provincialize the laboratory’ by focusing on the scientific tropics as a space of productive encounter and engagement. A view from the hospital reveals the tenuous process of ‘setting up’ a place for science, in a world that does not immediately recognize its value. The article examines the material exchanges of infrastructure, bodily tissues and labour that enable one young scientist to establish a scientific life for himself. The success of those transactions, it argues, ultimately derive from their objectification of scientific vulnerability and their enactment of relationships of mutual recognition. As opposed to asking how scientific knowledge is produced in the tropics, the view from the hospital challenges us to focus on the establishment of relationships between scientists and their hosts as a productive endeavour in its own right.

Keywords

medical research, tropics, global health, value, infrastructure

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Introduction: The hut

On 20 September 1871, the Russian man-of-war *Vitiaz* set down a strange trio of passengers in Astrolabe Bay, on the northeast coast of the island of New Guinea.

Twenty-four-year-old Nikolai Miklouho-Maclay, a trained natural scientist turned

ethnologist with a strong revolutionary streak, disembarked with the building equipment for a small cabin, a Swedish servant and Polynesian cook, a stack of notebooks and pencils, a microscope, a barometer, an atometer, a thermometer, and a collection of glass beads, nails and red cloth intended as gifts for the local inhabitants he anticipated meeting.

A stalwart defender of the single-origin thesis for all races, Miklouho-Maclay intended his scientific expedition to provide evidence for the equality of all men, and to give succour to political arguments against slavery. His first task, however, was to locate a site on which to build a hut to accommodate himself, his servants and his scientific equipment, so he could write up his scientific findings away from the mosquitos, inquisitive natives and often torrential rain. He settled on a small promontory overlooking the sea, only a few hundred feet from one of the native villages. ‘Thrusting my presence on them seemed to me to be tactless’ (Miklouho-Maclay, 1982: 69) he later wrote by way of explanation for that distance. The hut provided both shelter from and an entry-point to the tropics. It was New Guinea’s first field station.

Miklouho-Maclay strove to maintain his scientific objectivity with a strict daily routine that involved taking daily meteorological measurements, classifying local fauna and making detailed empirical observations and illustrations in his notebooks of physiological similarities between the local inhabitants and Europeans. Over the course of his first year in Papua New Guinea, his interest in the coastline’s fauna and flora diminished as his enchantment with its local inhabitants grew. Indeed, despite his aspersions to scientific objectivity, Miklouho-Maclay became famous for his social entanglements with those he studied and his eventual subordination of scientific

to political objectives, which led to his campaign for an independent Papuan State (Webster, 1984).

One story in particular has become emblematic of Miklouho-Maclay's scientific modesty, his recognition of dependence upon the goodwill of his hosts, and his cavalier methods. One day soon after his arrival, Miklouho-Maclay came upon a nearby village, only to be met by a suspicious group of men standing ready with their spears. Feeling intensely tired after his walk and carrying no weapons himself (he had resolved to leave his revolver at the hut), Miklouho-Maclay decided to lie down in their midst and go to sleep. After all, he noted, 'if I were to be killed, it mattered little whether I stood, sat, lay on a mat, or even slept' (Miklouho-Maclay, 1982: 83).

Today, we know Macaulay-Maclay as a maverick figure and an exception to the scientific imperial endeavour. While scientists elsewhere in the Pacific were insulating their scientific experiments from the social and cultural worlds of the Pacific inhabitants on whom they nonetheless depended, Miklouho-Maclay laid those dependencies bare. The image of Miklouho-Maclay's prone body lying in the midst of a circle of armed men is a perfect foil to Simon Schaffer's red coats disembarking from a warship in Honolulu harbour to protect a British astronomical expedition from angry Hawaiians, in 1874, only three years after Miklouho-Maclay arrived in New Guinea (Schaffer, 2012: 4). Of course, Miklouho-Maclay was also a man of his times. He had arrived in Astrolabe Bay on a Russian naval ship, and maintained close links to the Russian imperial government throughout his career (Fitzpatrick, 2012: 174). His aspirations, both for his own fame and the rights of the New Guineans he studied, were nothing if not grand. He was not beyond drawing his gun, if he had it with him (Lawrence, 1986). Yet, in acknowledging his momentary dependence on his hosts, he

also disarmed them and established the basis for the relationships through which his experimental ethnological work could proceed.

What insights could the story of a lone unorthodox scientist, who visited the shores of what is now Madang Province in Papua New Guinea in the 19th Century, possibly provide into the ways in which international medical scientists make a home for themselves and their science along that coastline today? With the rise of global health science, and the sheer number of machines, scientists and buildings that have arrived in Madang over the past decade, medical science already appears to be ‘set up’. Scientists arrive in a place that has long been transformed from a colonial outpost of Australian tropical medicine into a ready-made global health laboratory. Judging from the number of scientific publications emerging from research in Madang Province over the past decade, it can seem that global health science has become a smooth assemblage for the extraction of scientific (and economic) value from Papua New Guinean bodies, depleted health systems and tropical environments (Kelly and Geissler, 2011).

Recent social science writing about international medical research has directed attention to the stark material inequalities that have emerged between scientific and medical infrastructures (Crane, 2013; Geissler, 2013; Petryna, 2009; Rottenburg, 2009). Physical infrastructure, including buildings, technologies and clothing, such accounts have shown, enable scientists to both be in the tropics, and generate scientific facts that travel well beyond them. In places like Madang’s Provincial Hospital, physical infrastructures enable scientists to control their relationship with their surroundings through its transformation into a semi-field (Kohler, 2002).¹ Socio-technical assemblages allow scientists to extract authentic bodily tissues infected with tropical diseases while simultaneously protecting the tests they conduct on those

tissues from connections to ‘local’ places and peoples that would compromise their scientific validity (Street, 2014).

Yet the material sedimentation of scientific infrastructure along Madang’s coastline over the past century can also obscure the continued material fragility of scientific life. Every medical scientist in Madang must find a place to sleep, establish his own peculiar scientific infrastructure and negotiate the extraction of biological materials with his hosts. Indeed, in places like Madang Provincial Hospital, where the increasing interest of the global scientific community in hitherto ‘neglected’ diseases, like malaria and tuberculosis, has seen the slow creep of scientific infrastructures into the hospital wards and disused buildings. Newly arrived scientists find that dependencies on both their hospital hosts and ensconced scientists must be carefully negotiated in the making of a viable scientific life. The view from the public hospital, in contrast to the view from global health science, exposes those dependencies and draws attention to the material exchanges of equipment, money and bodily tissues through which scientists must negotiate a place for themselves and their science in someone else’s ‘home’.

In giving his own body up to the will of his hosts, Miklouho-Maclay acknowledged the value that their hospitality, assistance and bodies held for his science. It was a trick of double occupancy: a way of making himself at home in someone else’s abode, and simultaneously reconstituting that place as a scientific field. I suggest that, in Madang Hospital today, that trick of double-occupancy, of persuading others to accommodate one’s science, likewise requires scientists to render visible their dependence on their hosts. Here, material exchanges of infrastructure, bodily tissues and labour form the basis for scientific viability in the tropics.

What is at stake here is not the transformation of values of objects within scientific relationships, but the way that exchanges evaluate relationships. Before scientists can transform ‘subjectively’ valued body parts into ‘objectively’ valued scientific specimens (Anderson, 2012), their transactions with staff in the public hospital must first objectify the value of those relationships. The view from the public hospital, which is revealed in the following sections on scientific logistics, the ‘cross-hatching’ of medical and scientific infrastructures, transactions in bodily tissues, and the exchange of scientific labour, focuses our attention on the relational contingencies of ‘setting up’.

Experimental logistics

Despite his own trepidation about the impending arrival of more white men on the coast of New Guinea, Miklouho-Maclay’s makeshift scientific expedition was instrumental in the construction of New Guinea as a field of scientific inquiry and colonial endeavour. His notes and maps facilitated the arrival of the German New Guinea Company and the establishment of colonial plantations in 1885.² His writings directly inspired Bronislaw Malinowski to undertake long-term anthropological fieldwork in the 1910s, thereby permanently inscribing New Guinea in the ethnographic imagination (Malinowski, 1967: 155; see Knauff, 1999). Miklouho-Maclay’s own survival (and the death of his Polynesian assistant) enabled speculation about tropical disease and the survival capacities of different races that were to dominate colonial medical research for decades to come. The seismic waves of colonialism Mikouho-Maclay inadvertently set in motion eventually carried to Papua New Guinea such luminaries of tropical medicine as Robert Koch, Robert Barnett and Carleton Gadjusek.

Three decades after Mikouho-Maclay's arrival, the eminent German bacteriologist Robert Koch established a small research laboratory in one of the German New Guinea Company's first colonial hospitals, and set about using the microscope he had carried with him to research the epidemiology of malaria in the European, native and indentured labourer populations. In the decades of German and Australian administration that followed, hospitals remained nodal points in the circulation of medical knowledge, expertise and infrastructure across the territory: as places for extracting samples and specimens, for recruiting research participants, and as administrative headquarters from which scientists could travel into the field.

The yoking of medical research to colonial hospital infrastructures continued in 1968, with Australian virologist Macfarlane Burnet's establishment of the Institute of Human Biology in what had previously been the 'European Wing' of Madang Hospital. When the Institute moved to the grounds of Goroka Hospital in the Eastern Highlands in 1970, a Madang branch of what was now called the Institute of Medical Research (IMR) was established at the rural Lutheran-run hospital at Yagaum, about 20 miles from Madang Town. Yagaum had been established by the American Lutheran Missionary Doctor Theodore Braun after the Second World War, and was considered one of the best-equipped hospitals in Papua New Guinea. With ample space and convenient proximity to the rural populations who were becoming the focus of medical research during this period, it was deemed an excellent site for a malaria-focused research laboratory.

In 2009, the IMR Madang Branch was still located at Yagaum, but the missionary hospital had dramatically deteriorated, following years of depleted state and church funding. In the early 2000s, with many of its old wards disused and dilapidated, it had been downgraded to a health centre, and was running on a skeletal

staff. The majority of patients were travelling to the provincial government hospital in Madang Town for treatment. Madang Hospital's large catchment of patients and urban infrastructure now made it a more convenient place for a new generation of young scientists riding the wave of global health funding to undertake their research. In this era, tropical medical research has segued into resource-poor medical research and hospitals have become valuable 'fields' in themselves; naturalized spaces that authentically represent the material conditions of health care in the resource-poor tropics. The hospital, as an artefact of poverty and state fragility, has become the object of these studies alongside the bodies it contains (Street, 2014).

In the late 1990s, a young Australian doctor, who I call Dr. Halland, undertook a clinical placement at Madang Hospital. When he subsequently enrolled in a PhD programme, he drew on his contacts at the hospital to establish a clinical trial in the paediatric ward. Over the first decade of the 21st Century, the success of Dr. Halland's study, the institutional collaborations that grew out of it, and the rising international profile of malaria research, led an increasing number of scientists to the site. In 2009, Madang Hospital's chairman signed a memorandum of understanding with the Institute of Medical Research that was intended to mark the beginning of the hospital's transformation into what the chairman called an 'international research hospital'. Today, the hospital building is not only inhabited by a government-employed medical staff and patients, but is home to a transitory coterie of international scientists, funded by the Gates Foundation, the European Research Council and the Australian Research Council to conduct research on Papua New Guinea's prominent infectious diseases, including malaria, tuberculosis, HIV and meningitis.³

The expectations of an expatriate scientific lifestyle have also changed significantly since Miklouho-Maclay first arrived in New Guinea. A hotel with high security, a swimming pool, bar, restaurant and a large number of small cottages in its grounds is located only a few minutes walk from the hospital, and this is where many scientists stay when they first arrive in Madang. Many go on to rent long-term cottages on the hotel grounds. Here, medical researchers from Australia, the US and Europe can enjoy cold beer after a long day at the hospital, meet one another and share notes in a familiar cosmopolitan environment. Friday-night fish and chips at the hotel has become something of an institution for the town's community of international medical researchers.

It was into this 'networked archipelago' (Geissler et al., 2013) of hotel, hospital and research laboratory that Mark, a young postdoctoral researcher working for a malaria research consortium in Stockholm, arrived in early 2009. Mark was responsible for developing a research project to investigate the ways in which the vivax plasmodium parasite interacted with reticulocytes (immature blood cells). The malaria parasite targets reticulocytes, making them crucial for research into the way in which the disease is hosted in the human body. But scientists have found it difficult to obtain reticulocytes from total blood in the laboratory, hampering experimental work in the field. Mark's project aimed to pioneer new methodologies for extracting vivax-enriched reticulocytes by conducting experiments on placental blood, which has a higher proportion of reticulocytes, in a field where malaria is endemic and infected placentas are abundant.

After talking to his colleague, Mark read over a wealth of medical research published on Papua New Guinea that appeared to show high levels of vivax infection in the Madang area. The long-term sedimentation of knowledge and infrastructure in

the region – along with Mark’s personal excitement about Papua New Guinea as a truly ‘remote’, ‘tropical’ location and his desire to make a difference to a ‘developing country’ – made Madang an attractive place to do research. But the scientific life awaiting him was not as welcoming, nor as practicable, as it first appeared.

Before his arrival in Madang, Mark had presumed that he would collect placentas at Madang Hospital and conduct experiments at the IMR laboratory. Indeed, he had thought of these as resembling a research station and imagined they existed in close proximity. On his first day in the country, however, another scientist staying at the hotel drew him a map. ‘She said “here is Madang Hospital, here is Yagaum”’. The scientist explained to Mark that Yagaum lies at the end of a rough track off the Madang-Lae highway and that it is not safe to come back from Yagaum after 4:00 pm, because of growing numbers of hijackings and hold-ups. ‘But my project - the procedures were difficult, I had to do the experiments on fresh placenta.’ If the placenta was not transferred from the delivery room to the laboratory immediately, the quality of the blood samples could rapidly deteriorate, even over the space of two or three hours. It became apparent that Mark would need to collect his placentas from Yagaum’s health centre wards, rather than the hospital.

So I started spending nights in the nurses’ accommodation at Yagaum with my mobile on so they could call me if there was a delivery. But there were no deliveries when I slept there and I also didn’t sleep. So I was awake all night and then having to work in the day and I was thinking that I couldn’t do this for six months. It was so difficult. I had no car. Really during the day if there was a delivery at 2pm I would check it if it was positive, ok, but then I would have to go to town to eat something. It was really hard to fit life and work together.

Each morning Mark would call the IMR branch administrator to find out if there was a vehicle that could take him out to Yagaum. ‘Often I had to wait for the

car, and I knew that the experiments would take 4 or 5 hours. And then I had to get back before 4pm and it got dangerous. I tried to arrange something with IMR but I didn't have anyone with more power to fight for me.' There were no pre-established systems for the transportation of either scientists or samples between Madang's dispersed infrastructural sites. Mark's life became dominated by the complicated logistics of sustaining not only his science, but also his own life (eating, sleeping, security).

Mark's attempts to establish a reliable logistical apparatus were hampered by the uncertainty surrounding his relationship with IMR. The IMR is a government institution attached to the Ministry of Health. Like all medical scientists working in Papua New Guinea, Mark was affiliated with the Institute and had to gain approval through their ethical review board. What exactly this affiliation meant in practice, however, was unclear. 'We are not really with IMR' scientists repeatedly explained to me. Most scientists saw the relationship as a pragmatic exchange. They got to use the IMR infrastructure, and, in exchange, the IMR received funding for in-country overheads, employment for Papua New Guinean research assistants, and its directly-employed scientists appeared as collaborators on projects. Just what infrastructure IMR might provide, however, was often vague at the outset, and depended on the individual scientist's ability to negotiate with IMR employees. A scientist's leverage within those negotiations was often relative to the size of their project and the funding it was bringing in. Despite the IMR's large fleet of cars and drivers, for example, Mark was never clear whether he could ask for assistance with transportation.

The layered accumulation of colonial and developmental interventions in Madang has resulted in a scientific infrastructure that is spread out over space occupied by unsafe roads, dark nights and taciturn hosts (Street, 2012). Buildings and

roads stabilize scientific networks, but they do so impermanently (Gieryn, 2002: 36). The geographic distribution of infrastructure bequeathed by colonial science and medicine, coupled with growing security concerns, created uncomfortable infrastructural dependencies for scientists on their institutional hosts. The dust from the pot-holed roads that stretch between the physical remains of colonial medicine and science give what is commonly referred to as ‘global health science’ a distinctly postcolonial hue (Anderson, 2014).

Mark’s daily dependence on other people for transportation between hotel, health centre and laboratory became exhausting. He would often fail to get to Yagaum in time to collect his placentas, or he would get stuck there in the early evening when no one was available to give him a lift back to town. Eventually, Mark persuaded his employers in Stockholm to purchase a car for his project. ‘When I got it, the car changed everything’, Mark told me. Finally, he was able to negotiate the geographic gaps in the scientific infrastructure with relative autonomy from his scientific hosts. The story of global science is often told as a story of the development of scientific technologies and instruments that held networks stable and generated the same results in diverse locales (Law and Mol, 2001; Law, 1986; Latour, 1987). In Madang, amidst the physical debris of colonial and postcolonial infrastructures, the car can be as vital a component of the scientific apparatus as the centrifuge or the microscope.

Entangled infrastructures

Mark had another problem. Yagaum was not yielding enough placentas. There were substantially more patients at Madang Hospital, but the need for the placentas to be fresh and the distance between the hospital and the laboratory prevented him from shifting his research to the hospital’s labour ward. One day, browsing the internet

from his hotel cottage, Mark found a scientific paper that was based on similar research to his own, in Cameroon. The scientists there were collecting placentas and storing them in sterile solution for up to 12 hours. ‘They were better equipped so they had sterile trays, but I figured out that I could try the same thing with plastic bags and sterile solution.’ This meant that, if Mark could find assistants to put the placentas in the bags, he would only have to pick up the placentas from the hospital once a day and could take them out to the laboratory in his car in the afternoon.

Through his employers, Mark arranged for his research project to be shifted to Madang Hospital’s labour ward. Yet, on his arrival at the hospital, Mark found he had no clearly delimited research space, no coterie of assistants and no experimental apparatus. No one welcomed him. He had to make a place for his research from scratch. As global funding for malaria research has increased, and Madang Hospital has emerged as a particularly attractive site for research in the ‘developing tropics’, diverse research groups have begun to establish projects under a shared IMR umbrella but with different funders, institutional backers and research agendas. Mark’s research shared European funding with the other malaria research project on the delivery ward, which I call ‘MalVac’, and he had been under the impression that his research would be seen as a part of the larger MalVac project. He would, he assumed, be able to share their infrastructure and resources. But the scientists in charge of MalVac in the hospital seemed unaware of such an arrangement and no directions were given to the Papua New Guinean employed research assistants to assist Mark with his work or allow him to use their space or equipment.

By the time Mark arrived in the labour ward, MalVac had already established a research laboratory in one section of the room, which was bracketed off from the rest of the ward with high metal filing cabinets. It was made clear that there was no

space for Mark on the lab bench, and so he negotiated with the nursing staff to conduct his experiments in the private delivery suite at the end of the ward. For the use of this small, whitewashed cubicle, which housed a simple steel bed with stirrups and a shower, Papua New Guinean women pay an additional 20 Kina (\$8). Few were able to afford this and so the Nursing Officer in Charge told Mark that he could use the room as long as it was unoccupied.

The following entry from my field notes describes Mark's attempts to assemble a reliable infrastructure for his experiments:

Mark goes to check the delivery record first to find out how many deliveries occurred in the night. Three deliveries are recorded in the book so he checks in the cool box to see if the hospital nurses also collected the three placentas for him. They did. He carries the cool box into his side room. Then he puts on two pairs of gloves. He is working with blood and wants to be careful, but he is also running short on gloves and wonders out loud where he can get some more. He is hopeful this morning: the ward register stated that two of the placentas were from a first pregnancy, which increases the chance of vivax infection. Later he will also be able to use information from the register (the age and name of the mother, whether it is a first pregnancy, and the birth weight of the baby) in his publications.

He holds up a syringe and fills it with anticoagulant and saline solution. He normally borrows an apron from the MalVac research group, but after a bit of fishing around in their corner he decides to just do the test in his jeans and shirt. He explains that he brought two trays for his study with him from Stockholm, and MalVac use these but now he can't find them. He asks one of the hospital nurses if they have a tray that he can borrow and she hurries off to find him one. Luckily, it isn't too busy in the delivery room, otherwise she might not have been so willing to assist. He walks back over to the MalVac corner and takes a piece of sterile gauze. 'They are using my trays so I think it is fine' he says.

Back in the delivery suite, he puts the first placenta in the tray in the sink. He turns it so that the umbilical cord is underneath and the maternal side is on top. Then he cuts a small piece of the placenta away and moves back over to the bed, which he is using as a makeshift laboratory bench on which to lay out his slides. He smears the piece of placenta on each of the two slides. One slide will stay in the hospital laboratory. The other will go to the IMR laboratory at Yagaum.

A MalVac nurse, Benjie, comes into the ward. Mark asks him where the trays are. Benjie says 'I don't know, I think they are at Yagaum.' Mark says 'They are here. I can't remember if I brought one of them or both of them, but at least one should be here for my study.' Benjie leaves the room without responding.

Mark felt uncomfortable in the hospital, where other projects with more money and more scientists seemed already to have made themselves at home. MalVac, Mark noted, appeared to have a different, more established relationship with the hospital: ‘it must be part of a bigger agreement with the hospital because they have put cupboards for files inside the delivery ward.’ Ironically, this closer relationship with the hospital management enabled more autonomy from the hospital’s infrastructure and staff, as evidenced by the wall of filing cabinets. Mark, in contrast, often found himself carrying out his laboratory tests on an empty ward bed, or on the floor in the corner of the room. He had very little, if any, exclusive infrastructure for his project. His hospital laboratory was also a labour ward. The laboratory bench was also a delivery bed. Sometimes he had to borrow trays from the hospital.

The movement of equipment to and from Papua New Guinea materialized old inequalities, engendering resentment among hospital staff and awkwardness among the scientists. Simple items, such as a metal kidney tray or high quality latex gloves, could be difficult to obtain in Papua New Guinea. Scientists did not know what equipment would be available before they arrived, making it difficult to plan what to bring with them. To carry out the most basic of tasks they often became reliant on exchanges with hospital staff, or with other scientists who they did not know and with whom they could later find themselves competing for discoveries and funding.

The specialized technology scientists brought with them was the source of much resentment amongst the hospital staff. It was exclusive to the research hospital and yet it occupied public hospital space. Most of the comments made by hospital staff about the growing presence of medical research in the hospital focused on the superiority of the scientists’ equipment over the hospital’s old and unreliable

diagnostic technologies, and on the scientists' perceived lack of contribution to the hospital as a site of medical care.

The increasingly complex array of 'ethical' obligations that accompany medical research in Papua New Guinea require international medical scientists to invest in future 'research capacity' in the country, including investment in infrastructure. In Madang Hospital, such investment has led to the renovation of disused buildings into research laboratories, and the employment and training of local health workers as research assistants. As Ann Kelly notes in relation to a malaria field trial in Tanzania, within the inherently asymmetrical conditions of scientific practice, the infrastructural conditions of research can also 'reconfigure the researcher as guest' (2012: S148). In the case she describes, scientists had to build a well and two out-houses before residents were happy to accommodate their experimental huts. In Madang Hospital, however, researchers' investments in its physical spaces are often perceived as attempts to colonize the hospital's public infrastructure for research. Hospital staff do not accommodate science voluntarily, but because they are told to by their managers.

Nonetheless, international science does not always have ample resources, and scientists like Mark often have to cobble their equipment together, depending on colleagues and institutions elsewhere. These scientists do not always have a choice over what they take with them when they depart and what they can leave behind. Moreover, stark inequalities between 'global' science and 'local' public health, which were the focus of hospital staff, can mask inequalities between research projects, relevant institutional support and infrastructural resources.

Mark was highly aware of the infrastructural inequalities between the research hospital and the public hospital, and he was concerned about the legacy that his

project would leave behind in the institution. When preparing for his trip to Papua New Guinea, Mark realized that he would need a fluorescent microscope. His supervisor refused to buy one, because it was too expensive, so Mark found a group in Stockholm that had an unused one in their laboratory. 'They said that I could bring it with me but that I would have to take it back for them afterwards. I found that difficult because they weren't using it. I think they would have a lot more use for it here.' He also needed a cryostat to slice the placenta tissue into thin pieces of tissue. He wrote to the Director of the Institute of Medical Research to ask if there was one in the country. 'It didn't need to be here, just anywhere in the country. He told me "no, but it would be good to have one." They try to ... if he says that, maybe one person in ten would bring one. But I don't know who would spend that for a six-month project. So I got my supervisor to send it to me.' Again, he had been told this piece of equipment would need to go home with him when his project ended.

In other cases, equipment could remain in the hospital, but was not perceived to be appropriate for the material conditions of the Papua New Guinean health system. The MalVac study, for example, required the scientists to measure the hemoglobin of pregnant women. To circumvent the unreliable hospital laboratory, the researchers transported a portable machine to the hospital that would enable rapid testing of hemoglobin on-site. The hospital nurses frequently mentioned to the IMR nurses that they would also like one of those machines and there was some discussion among the MalVac scientists about whether they could leave the machine at the end of the project. The problem was that the machine required the blood specimens to be inserted in disposable cuvettes, which could not be purchased inside Papua New Guinea and were very expensive. 'Once we leave we can leave the machine, but will the hospital be able to buy the cuvettes?' the scientists wondered.

From their own perspective, the scientists' inability to meet the expectations of hospital staff for the exchange the scientific equipment had sound, practical foundations. Either the equipment was already tied into circuits of scientific exchange elsewhere, or it was not deemed appropriate for a low-resource hospital setting. Hospital staff had a different understanding of the exchanges. Many of the hospital staff felt they did not benefit from the presence of researchers in the hospital, and were unhappy about the palpable inequalities between the international scientists and the public sector workers who had to keep the hospital going and administer care under strained conditions. The international researchers tended to socialize together, indeed many of them lived together, and the hospital nurses and doctors complained that the scientists did not recognize them (*luk save*) or seek to build personal relationships with them.

While they were often motivated by humanitarian ideals, the scientists often admitted they found their relationships with Papua New Guineans awkward and confusing. As Dr. Halland, who had made substantial efforts to be sensitive and thoughtful in his dealings with the hospital, said to me of his relationship with hospital staff, 'we don't share any cultural reference points so you wouldn't really expect us to actually make friends with one another. It makes sense we would want to spend time with people who are like us.'

From the perspective of the hospital's public employees, however, the differences between Papua New Guineans and Europeans did not preclude the possibility of productive relationships. The scientists were living off the hospital's infrastructure, and their perceived refusal to reciprocate through the gifting of scientific equipment was interpreted as a refusal to recognize the value of their relationship with their hosts.

In Madang Hospital, shared information systems, buildings, water and beds mean that scientists primarily negotiate their relationships with other inhabitants through engagements with equipment and infrastructure – through issues of whether an item is exclusive or not, who is able to use it and whether it will be left behind after the scientists depart. The overlapping spatialities of the research hospital and the public hospital are reminiscent of the dystopian double-city created by China Mieville in his novel *The City and the City*. In that book, two cities, the increasingly run-down Bezel and the economically up and coming Al Quoma, share physical geography (Mieville, 2009). Much of the infrastructure for the two cities is mutual. In areas of ‘cross-hatching’ they also share roads, pavements and even buildings. Other areas are municipally exclusive, and citizens of each must carefully navigate the boundaries between the two cities, through their daily interactions with people, infrastructure and objects. In Madang Hospital’s labour ward, a space of ‘cross-hatching’ between the research and public hospital, the material inequalities between the two hospitals are made visible, but so are their co-dependencies. The research hospital may have newer, more expensive and polished equipment than the public hospital, but it remains critically dependent on the latter for its infrastructure, including physical space, water and power.

Such infrastructural dependencies were made distressingly clear to Dr. Halland early on, when the pediatric ward nurses unplugged a specimen fridge in order to watch the State of Origin rugby game, leading him to lose three months of specimens that had been awaiting shipment to a laboratory in Australia. For hospital staff, the refusal of the medical researchers to acknowledge this dependency through personal exchanges, and therefore their refusal to acknowledge their fundamental

human equivalence with the hospital staff, raised questions about the legitimacy of their presence on the ward.

Fresh specimens

Having read numerous papers that described high rates of vivax malaria before he arrived, Mark was given a paper by a colleague soon after his arrival that showed there was in fact very little vivax in pregnancy in Madang, possibly because of the recent distribution of bed nets coordinated through the Global Fund to Fight AIDS, Tuberculosis and Malaria. The paper checked 400 placentas at two nearby health centers and found that only 4 were infected with vivax. Mark realized he would also need to do research on falciparum malaria, which still had a high prevalence, in order to get enough results. But another group was already researching falciparum-infected placentas in the hospital. Through IMR, Mark was able to negotiate a collaboration: ‘they said that I can do the study but only to test the antibodies that they have developed.’ Mark was not completely happy with this arrangement, but felt uncertain about how relationships between research groups were brokered and by whom.

Meanwhile, Mark’s access to any vivax-infected placentas at all was becoming tenuous. In the beginning, Mark was given the placentas of the MalVac ‘study mothers’ after the team had finished with them. But they were often too damaged to use and Mark soon realized he would need to collect placentas from ‘general mothers’ too. He didn’t have any staff to help do the collection, and most of the deliveries took place at night when, for security reasons, it was impossible for Mark to be on the hospital ward. One of the MalVac-employed nurses offered to help collect the placentas alongside his other tasks. In return Mark, offered some specimen bags from Europe, which the MalVac team did not have. The nurse also asked Mark

for a significant monetary loan, to pay to record a music album. After a few days, however, the MalVac scientists told the nurse that he was not being funded to assist Mark's project, and would have to stop. Mark felt upset by this, and was ultimately let down by the IMR nurse, who never returned the loan. Mark still let the MedVac nurses use his bags: 'the nurses say thank you but I am not sure if [Doctor C] notices.'

Before Mark arrived, he understood that he would have access to the blood of the study mothers who tested positive for vivax. 'But the MalVac slides are not read until much later so I couldn't also study the material collected. They were storing them for later. And I can't take more venous blood from the study women because they have already given samples. So there were a lot of incompatibilities in the projects.' These incompatibilities became visible when the MalVac team was invited to present their findings at a large malaria conference in Senegal. Because they had not yet read their own slides and so did not have any data to present, they asked Mark if they could use his results. Nonetheless, Mark was told he could only present results from MalVac study mothers, 'But I couldn't talk about study mums because of the incompatibilities. My data was from general [hospital] mums. In the end I wasn't invited to go. But I don't know if they presented my material. They needed something from me, but when I needed something they didn't give it.' Given the complexity of international networks of funding and research, there was often ambiguity over whether scientists should be cooperating or competing. These tensions were exacerbated by the scarcity of infrastructural and biological materials. It seemed to Mark that MalVac, because of its more imposing physical set-up, had greater control over where their projects did and did not overlap.

Through the establishment of an elaborate physical infrastructure, some research projects were able to make greater claims to specimens and data in the

hospital. When a group of Australian scientists established a research project on malaria and meningitis in the pediatric ward, they also converted a disused ward at the back of the hospital grounds into a small research laboratory. This enabled them not only to carry out all of their own tests on site, but also to ‘give back’ to the ward by carrying out tests for all of the wards patients, whether they were enrolled in the research study or not. This assisted the doctors on the pediatric ward, who otherwise waited days for unreliable tests from the hospital’s understaffed and under-resourced laboratory. But by expanding the remit of their laboratory beyond the formal parameters of their project, the researchers also expanded their scientific terrain. When a pair of medical students from Europe carried out research on changes to the meningitis treatment protocol in the ward, they were later told they could not publish their findings because the data belonged to the Australian research team. The students had not included the Australian team’s research participants in their study, but because they were carrying out all the tests on the ward, the Australian team also laid claim to the pathology data for all the patients. ‘The results still belong to the hospital’, complained the medical student, ‘What if the hospital wanted to use them? Would they have to ask IMR?’⁴

Like the Eastern Highlands, where Carleton Gadjusek competed for kuru specimens and scientific sovereignty with Australian researchers, Madang Hospital in the first decade of the twenty-first century was a crowded space. Like scientists’ competition over kuru-infected brains in the 1950s, as described by Warwick Anderson, the scientific demand for malaria-infected body parts today far outstrips the supply. In the new ‘scramble for the tropics’ (cf. Crane, 2013) competition over biological subjects, specimens, infrastructure and data can make the research hospital a hostile place for scientists who do not come equipped with a ready-made research

team, experimental infrastructure and funding. The need to negotiate exchanges of biological specimens and experimental equipment within uncertain and often ambiguous relationships means lone scientists like Mark can never guarantee that they will be able to manufacture or sustain a viable scientific assemblage.

Research on cord and placenta blood is particularly fractious. Reticulocytes are important, but they are scarce. They only make up 1% of cells. The discovery that there is a higher percentage of reticulocytes in cord and placenta blood makes them particularly good for experimentation and has spawned a gold rush for this material in malaria endemic areas. Placentas are also valuable because, unlike body tissues such as blood, they are classified as hospital waste and do not require that elaborate ethical protocols be followed prior to use. This makes the placentas both more desirable, and more divisible, as multiple scientists can use the same placenta for different projects without the need for additional permissions.

The distinction between bodily tissues and waste is premised on the fact that placentas have already been spontaneously discharged from the human body, and have therefore become a separate 'thing'. In contrast, blood requires active extraction from the research participant's veins. As the following section makes clear, however, the fantasy that placentas are alienated 'waste', with no attachment to the bodies from which they emerged is complicated by the presence of unexpected mediators. These reveal the persistent connections placentas retain to places and persons, and expose the labour entailed in their transformation of value within diverse tissue economies (Waldby and Mitchell, 2006).

Scientific labour

Mark injects the anticoagulant into the placenta and uses another syringe to take a blood sample from this same spot. He then places the placenta back in the bag,

rinses out the tray and wipes up. He explains that, if the placenta is more fresh and bloody, then he will get more experimental pellets from it after he has put it in the centrifuge. But that depends on whether the placenta has been handled carefully, so the membrane hasn't broken, and on whether it has been properly covered in the anti-coagulant before being put in the cool box. Mark points to the A4 piece of white paper stuck to the ward fridge with sellotape. Written on it in blue biro is Mark's daily protocol for the hospital nurses:

8pm-8am: Put placentas in the bag in the esky
8am-9am: Mark will inform of positive malaria to nurse on duty.
9am-10am: Give information sheet and informed consent sheet to mother, fill in questionnaire. Store them in 'filled-informed consents'. Collect 5mls of venous blood if mother consents.

'But', he explains, 'they don't always follow it. I am not paying them so I depend on their good will'.

After the MalVac nurses were told to stop assisting him, Mark was forced to ask the hospital nurses to help him collect the placentas.

I didn't have the support of MalVac nurses. I felt lonely. I felt very lonely. But with time I managed to ask for the help from the hospital nurses. The ones who didn't take any profit. I had a meeting with them and I explained the project and asked if they wanted to help me. I said it would be good for the women and that they are the only ones who I have to help.

Mark needed the nurses to collect the placenta after a woman delivered, to inject anti-coagulant, place it in a specimen bag, cover it in sterile solution and store it in the small cool box he provided. The willingness of some nurses to help Mark made him feel more comfortable in the hospital. He began to believe that his project might be feasible after all. It was not long, however, before Mark's relationships with the nurses also developed complications.

Each morning Mark would check the labour ward register to see how many deliveries had taken place overnight. The number of deliveries should correspond to the number of placentas in the cool box. But each time one particular nurse was on duty he noticed there would be fewer placentas in the box than there were deliveries. After several thwarted attempts to speak to the nurse personally, he wrote a letter:

I said it was her right not to collect them. But not only was she going against me, she was going against her other colleagues and against the women who suffer from malaria and the babies who might die from malaria. I am not here on holiday. I want to get a vaccine for malaria in pregnancy. I wanted her to know that. The following day there were two placentas in the esky She came and apologized to me and said she hadn't understood. But then she got her revenge because there were five deliveries and she didn't collect any and then she went on leave the next day so she didn't see me. Why systematically doesn't she collect? She is the only one. Then I fear that she will come back and I will miss a lot of deliveries. I don't know how to approach the situation.

Mark talked to some of the other nurses about the incident. It seemed that something about which Mark had not thought at all, what happened to the placenta after he had finished with it, was highly significant for the nurses who were left to deal with the remaining material. The nurses explained that the hospital incinerator was broken and there was no hospital system for disposing of the placentas, so after Mark had finished his experiments they had to wrap the placenta in paper and a plastic bag and return it to the mother. But there was often a long delay before Mark could return the placentas. He had to wait for the laboratory results before he could give the placenta back, because he might need to take a third smear, or use PCR to determine infection. Sometimes, the ward got too full and the nurses had to discharge the women before Mark had returned the placentas. Sometimes the mother refused to take the placenta because she was travelling with her husband, to whom it was deemed hazardous. In those cases the nurse would have to bury the placenta herself, in her back garden in the compound behind the hospital.

'I feel sorry for that' Mark explained, 'because if it was not for me they could give it back, so I said to the nurses, "ok if you know you are going to discharge her then give her the placenta. Don't wait for me."' But still some women leave without notifying and then they leave without the placenta.' One nurse began to ask why there were no IMR staff to give the placentas back. 'She said it wasn't her duty to do this.

So I said I would do it because I couldn't ask [the MalVac team]. But then I thought this wouldn't look good. A white man with a tray cannot give it back, they will think "what is he doing with the placenta?" It has to be the nurses.'⁵

The classification of placentas as 'waste' implies that they are devoid of meaning or value and have been divested of any personal ties of ownership or sentiment. Placentas, scientists insist, are neither donated nor taken; they are simply available for appropriation. Yet waste must be disposed of. And the means of scientific disposal are intriguing. The placenta is categorized as waste when it is expelled from the mother's body, is turned into a scientific specimen through processes of storage, labeling and experimentation, and is then re-categorized as waste, at which point it is returned to the mother, implying that the original act of separation was never complete, and the placenta had never been wholly alienated in the beginning.

From the mother's perspective, it is precisely because the placenta is still embedded in a constellation of relationships that it can also have relational effects, in this case on the men in the family of the woman who delivered it. The proper thing to do with a placenta, women told me, is to bury it on the new child's paternal clan land. Ethnographies from other parts of Papua New Guinea suggest this establishes enduring connections between the child, their ancestors and the land (Bonnemère, 2009; Merrett-Balkos, 1998). Yet, once a placenta is separated from the woman's body and is exposed to the steamy coastal air, it begins to rot and smell. This, women told me, makes it potentially hazardous, especially to men. Wrapping a placenta in banana leaves and transporting it from the house, bush, or even rural health centre where a woman gives birth to an appropriate place of burial is usually fairly straightforward. Transporting it in a plastic bag on a hot public bus back to their

settlement or village both speeds up the placenta's decomposition, and extends the timeframe in which people can be exposed to its polluting effects. Even the smell of the placenta in that close, steamy environment is harmful, and women feared that they would ultimately be held to blame from any sickness that resulted. Given the distance between the hospital and an appropriate site for disposal, the return of placentas to mothers was problematic, and they probably would have preferred them to remain hospital waste.⁶

Mark was aware that in desiring placentas, and therefore revealing the value they have for science, he was disturbing their institutional status as waste. As in many other locales of global health science, rumors of white men stealing organs are common in Papua New Guinea. Such rumors are perhaps even more prevalent in Madang, where the story of an IMR team, led by an American medical anthropologist, that extracted and subsequently patented a cell line from a remote Madang tribe was widely documented in the national media and continues to circulate through urban institutions and rural villages alike; the story prompted what is known as the 'hagahai saga'.⁷

In the Eastern Highlands, Gadjusek also had to contend with Fore concerns about his intentions for their loved one's body parts. But he learnt that, once the possibility of a potentially long-term relationship of reciprocal exchange with the scientist became apparent, the Fore were willing to let him cut up the bodies of their wives, mothers and children and extract their brains. As Anderson describes, this created other problems for Gadjusek. As he became burdened by Fore expectations, he fantasized about the cannibalistic possibilities of extracting body parts without the need for reciprocity (Anderson, 2009; 2012). If only brains self-alienated like placentas!

The implication that local concerns about the extraction of body parts revolve less around the violence of extraction, and more around the nature of the relationship that ensues, is reinforced by James Leach's ethnography from the Rai Coast of Madang Province, in which he argues that people see white people's desire for Papua New Guinean body parts as a potential basis for productive exchange (Leach, 2005). Relationships are often founded in moments of violent extraction that effect the differentiation of persons. White people's extraction of Papua New Guinean body parts therefore becomes the basis for mutual recognition of the value each person brings to the relationship. From this perspective, transacted body parts reveal the value of persons and relationships, rather than exchange being a process of persons attributing value to objects (Strathern, 1988).

That the extraction of placentas requires no negotiation with research participants (indeed, they only formally become research participants once their blood has been taken) is a relief to scientists. But the acquisition of placentas does require negotiations with hospital staff. It is the hospital nurses who, by placing the placenta into a specimen bag with anti-coagulant, enable its transformation from waste into scientific resource. After the scientist is finished with the placenta, it is also up to the nurse to wrap it in paper and return it to the woman from whom it was first discharged, thereby firmly reinserting it back into the moral economy of kinship. One way of analyzing such transactions is to focus on the ways in which the placenta acquires different kinds of value as it moves through diverse economies of kinship, medicine and science, and the role of the nurse in facilitating those value transformations.⁸

For the nurses upon whom Mark depended, however, the movement of the placenta around the hospital reveals the value that people accord different

relationships. Like scientific research projects elsewhere, Mark was dependent on the voluntary labor of people with ‘local knowledge’ (Kelly, 2011), but those relationships were not institutionalized and could not be taken for granted. Instead, he had to experiment with ways of making their involvement with his research appear valuable to them.

Nurses in Madang Hospital are ambivalent about scientific research. There was a clear distinction in the hospital between research assistants, who are employed through IMR and received additional training to carry out research related procedures and protocols, and the hospital staff, who for the most part are not involved in research related activities. This means that *research* capacity building is largely kept distinct from *medical* capacity building (Street, 2014) and there are few opportunities for research practice to directly inform routine hospital care. This situation presents a stark contrast to that which sociologists JuLeigh Petty and Carol A. Heimer describe in HIV clinics in Uganda, Thailand and the US (2011). They explain how everyday bureaucratic and care practices in those clinics were directly shaped by staff involvement in research projects. This smoothed the way for adoption of clinical research results. Madang Hospital staff do not routinely benefit from direct involvement in medical research, although they do acknowledge that the hospital could benefit from any changes in drug protocols that follow from research results. Several of the research studies carried out in Madang Hospital, including the malaria treatment trial carried out by Doctor Halland in 2003, have prompted changes to national standard treatment protocols. Nonetheless, none of the hospital staff I spoke to professed to be aware of such cases and most staff maintained that the international scientists stood to benefit more from their research than the Papua New Guinean health system.

Nurses often feel that their work of caring for patients under difficult circumstances goes unrecognized by the scientists, who appear to be more focused on their own careers and scientific fame. Mark's appeals to civic virtue, the idea that they were morally obligated to assist in order to help 'the women who suffer from malaria and the babies who might die from malaria', fell on deaf ears. Not that the nurses were not concerned with the suffering caused by malaria, but they were faced with suffering every day and the work they did to ameliorate it largely went unnoticed by hospital managers, doctors and now foreign scientists alike. Nurses disinterested in becoming 'invisible technicians', was not because they were concerned about Cartesian distinctions between scientists and technicians (Shapin, 1989), but because they understood their relationships with scientists to be premised on transactions of mutual recognition rather than hierarchical authority.

So why did (some of) the hospital nurses assist Mark? Ironically, Mark's marginalization within the research hospital and his lack of established infrastructure was key to his acceptance by the hospital nurses. He was on his own, and his plea for assistance was understood as recognition, of sorts, of their capacities. When he called a meeting and asked for their assistance, the hospital nurses said that they felt acknowledged by him. He could see they were capable of carrying out research. The small gifts he was able to give them in exchange for that work, including pieces of scientific equipment, like thermometers, or access to research equipment, or even, on one occasion, much needed money for a family member's funeral, objectified the value that relationship had for Mark. '*Em i luk save long mipela*' (he recognizes us) one nurse, Lois, told me. In recognizing his own dependency on the hospital staff, Mark opened up the possibility of a relationship premised on equivalence and reciprocity, as opposed to extraction. The placentas were not immediately available to

Mark as alienated, neutral waste, and the relationships through which he was able to acquire them were not without friction. But they were relationships premised on the productive potential of scientific vulnerability, as opposed to control and hierarchical authority.

Conclusion: Accommodating science

International funding has seen the creep of scientific infrastructure into Madang Hospital's wards, through the transformation of an unused delivery bed into a lab bench, the refurbishment of an old unused ward into a research laboratory, and the typed-up experimental protocols for hospital nurses that are taped onto swing doors, equipment cupboards and nurses stations. Yet Madang Hospital can be an unwelcoming place for international scientists. The scientists depend on the hospital for a supply of research participants, biological materials and medical equipment, and they must also share hospital space with staff for whom postcolonial inequalities continue to be materialized in the spaces where hospital and scientific infrastructures diverge.

The research hospital is not a unified scientific space. The product of a competitive international research environment, it is the site of multiple, intersecting and overlapping research projects, belonging to different universities, research institutes and consortiums, often with very different levels of funding. Indeed, for some scientists, the cohabiting and competing scientific projects are inhospitable and highlight the precariousness of their knowledge-production endeavour. No clearing is made for the science here (Heidegger, 1962). Rather, scientists arriving from Europe, Australia and the United States struggle to gain a foothold, find a place for their

equipment, negotiate access to someone else's, or develop the collaborations necessary to make credible and useful scientific knowledge.

Historians of science have pointed out that as places of science become more established they also tend to become more exclusive (Shapin, 1988; Kohler and Kuklick, 1996). So it is that I have focused on the initial stages of Mark's project, his attempts to 'set up'. And yet, in the contemporary global science economy, the process of setting up can last the duration of the project. Mark's fieldwork in Papua New Guinea was only scheduled to last 6 months. Returning to Madang Hospital in 2013, I found that nearly all the scientists I had known on research trips in 2009, 2010 and 2011 had already left.

Madang's scientific infrastructure has never coalesced into a research station in a traditional sense. It is stretched out across the province, and its pre-eminent research site, the Provincial Hospital, is an operational public hospital, not a ready-made laboratory. The extractive capacities of global health science are not given, nor is the capacity to control boundaries between science and field. Scientists are already in the hospital, and they have to persuade its inhabitants to accommodate them.

Questions about the relationship between science and place have often focused on the ways in which the credibility of knowledge is negotiated in relationships between scientists. For scientists working in the resource-poor tropics today, scientific credibility depends on their capacity to tread a fine line between the authenticity of place and the universal validity of their results. In a public hospital, this can involve the construction of a complex material apparatus that incorporates some elements of hospital infrastructure and excludes others.

That is the view from global health science. The view from the hospital tells a different story, in which relationships with a future community of judgemental

scientists may not be the priority for scientists. Before they can worry about the ways in which the specificity of such places contributes to or detracts from the credibility of the knowledge they produce, they have to worry about how to make that place accommodate science. The particular institutional histories of many postcolonial research hospitals may generate tensions between scientists and their hosts.

Distinctive about Papua New Guinea is the emphasis that hosts place on transactions, and their concern with the ways those transactions reveal the value of relationships. This can also help refocus social studies of scientific value production.

Recent work on scientific economies has emphasized the ways in which bodily tissues, scientific labour and medical technologies are transformed as they move through different regimes of relational, epistemic and economic value (e.g. Cooper, 2009; Geissler and Kelly, 2011; Sunder Rajan, 2006; Waldby and Mitchell, 2006). In a recent article in this journal, Warwick Anderson (2013) draws on anthropological theories of value to explore ‘how interaction, or opening ourselves to others, can form and make visible our values and valuables’ in scientific encounters (p.557). He shows how transactions of brains between Gadjusek and the Fore, which made the value of social relations visible, were gradually superseded by transactions with other scientists that located value in the object itself.

By shifting the analytic focus from the mechanisms of scientific value production to a prior moment of establishing scientific legitimacy, and the processes by which scientists make a home for themselves in the tropics, relational value again takes prominence. That is, within the hospital, scientists must engage in transactions with their hosts on their hosts’ terms. And these terms are ones in which transactions primarily reveal the value of relationships rather than things.

Gift exchanges in Melanesia have been shown to be ‘the privileged means for defining and making visible social relations and identities’ (Foster 1999 167). In her ethnography of inter-island exchange in the Massim area of Papua New Guinea, Nancy Munn explains that material transactions realize the symbolic value of the people who exchange them. The giving of food to overseas visitors, for example, spatio-temporally extends the person, and the fame of Gawa (the island where her research was conducted) as a place (Munn, 1986).

Hospital staff in Madang were not necessarily engaged in a prestige economy or concerned with ‘fame’ as a primary value, but they were concerned with recognition, what they call ‘*luk save*’. Recognition of a relationship usually takes the form of reciprocity, in Mark’s case through small gifts of equipment and resources. But making one’s dependency explicit, as Mark did when he pleaded with the nurses for their help, is also a form of recognition.

Miklouho-Maclay introduced a physical infrastructure for science and scientific living that opened the way for the transformation of the Madang coastline into a field of scientific knowledge. Yet he remained highly aware that the short stretch of coast he patrolled was not only or even primarily a scientific field. It was also a place for living, and he was a guest in someone else’s home. Within the crowded world of Madang Hospital, Papua New Guinea, situated less than 20 miles from the small promontory on which Miklouho-Maclay built his hut, and today inhabited by a dis-unified congregation of patients, nurses, doctors, research subjects and malaria researchers, this article tells the story of another lone scientist as he sought to establish an experimental apparatus for his malaria research project.

In an era of large grants and international consortia, Mark arrived in Madang Hospital notably alone. Nonetheless, Mark’s story is unexceptional. Many scientists

arrive in Madang with limited resources, in confusion about the institutional arrangements and support available, uncertain of their authority, and as strangers to other scientists and hospital hosts alike. Mark's lack of pre-existing connections to the place in which he had to work draws attention to the tenuous materiality of all science in the Pacific, and the often uncertain, ambiguous exchanges through which it proceeds (Anderson, 2012).

How does science make a home for itself in a public hospital? Like Miklouho-Maclay, who made a home for his science by lying down in the middle of a group of men holding spears, scientists in Madang's research hospital sometimes have to recognize their role as guests in someone else's home and make a plea for their accommodation by others, based on transactions that reveal the value of relationships rather than the value of things.

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Author biography

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New Guinea and South India. This includes research on hospitals as socio-technical assemblages, the international transfer of managerial technologies, and market-based health solutions for ‘hard to reach populations’. She is the author of: *Biomedicine in an Unstable Place: Infrastructure and Personhood in a Papua New Guinean Hospital* (Duke University Press, 2014).

¹ The tension between the need to maintain the credibility of one’s findings at the same time as maintaining the representative connection between those facts and the location in which they were produced has been described by Henke (2000) and, in relation to tropical medical research, Kelly (2012).

² Miklouho-Maclay had met the German explorer Otto Finsch in Sidney and, believing he was of the same political persuasions as himself, gave him valuable information about the Maclay coast, including important terms in the local language. Finsch later used this information as Bismarck’s Imperial Commissioner to seize the north-east portion of the island as a German Protectorate.

³ See Street (2014) for a longer history of medical research in the country.

⁴ There is a striking analogy here to the story Joanna Crane tells of an HIV research project located in a rural clinic in Uganda. In that project the scientists ‘donated’ a computer and data management system to the clinic, only to complain when the clinic formed collaborations with other researchers and allowed them to use the patient data contained on the computer (Crane, 2013).

⁵ Mark is referring here to the rumors and anxieties that surrounded scientists’ extraction of bodily fluids and collection of body parts and excuviae in the hospital, practices traditionally associated with sorcery. Such rumors are not particular to Papua New Guinea had have also, for example, been encountered by scientists working across the African continent (Fairhead et al., 2006; White, 2000).

⁶ This account contrasts with that Merritt-Balkus gives of Anganen women in the Southern Highlands of Papua New Guinea, who demanded the return of their placentas when the nurses at the mission health centre they gave birth in removed them. The difference may be explicable on account of the distance that women in Madang Hospital must potentially travel to return to their village or settlement.

⁷ For more on the hagahai saga see Strathern (1999) and, more recently Anderson (2012).

⁸ Following objects through relationships in order to observe the different value they are accorded in different transactional contexts is a conventional analytic technique employed in the anthropology of value. See, for example, Appadurai’s classic essay on the social life of things (1988) or, more recently, Henry et al.’s discussion of how the value of ethnographic artifacts is transformed through transactions between indigenous producers, European collectors, museums and the state in Australia (Henry et al. 2013).