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Orbiting in the field: A *taidan* (conversation) on ecology and filmmaking in Tohoku Japan

Ian Thomas Ash and Timothy A. Mousseau, with an introduction by Lisa Onaga

ABSTRACT

Filmmaker Ian Thomas Ash and biologist Timothy Mousseau have orbited one another in the courses of their fieldwork in and around Fukushima, Japan since 2011. One traces human stories; the other tracks signs of biological change in wildlife. Both had investigated questions about the exposure of bodies to radiation. Their paths crossed at a workshop entitled “Exposure and Effect: Measuring safety, environment and life in Asia” at Nanyang Technological University, Singapore, where they discussed the meanings of their research and work. Questions as to what new insights would be drawn about the difficulties, challenges, and futures of conducting work in the field known as “Fukushima” motivated the organization of their sustained conversation in the face-to-face format known in Japanese as *taidan.* This dialogue lays bare the problems characterized in the genba, raised in this special issue, when generators of knowledge seem incapable of meeting on common ground to address uncertainties about pollutants, radioactive or otherwise, despite treading over the same figurative or physical ground. This essay introduces and analyzes key extracts from the transcribed *taidan*, now archived as an oral history document

as part of the Teach311.org project. The *taidan* ultimately serves as a clarifying example of the need to excavate the relationships among places, radioisotopes, and research that have come to define human relationships. The issues raised by the *taidan* enhance our familiarity with how studies of radiation effects in the "wild" involve unique learning processes typified by the very experts conducting fieldwork who have had to confront their own assumptions about the characterization of a place in relation to radiation exposure. The independent works of Mousseau and Ash, documenting a shared historical moment within a world humbled by renewed awareness of ionizing radiation, juxtaposes the creation of expert and lay knowledge systems. Their work at the crosshairs of science, technology, and society show as many commonalities as they do distinctions. For Asian studies cases that feature unavoidable deliberations about trustworthy scientific knowledge, a science and technology studies (STS) lens can help contextualize technological mediation, methodologies involving non-adult humans who do not necessarily have authorial voices, and the challenges of negotiating contested objectivities.

Keywords: Fukushima, Japan, mothers and children's health, radiation and dose effect, animals and environment, fieldwork, technology and society, documentary filmmaking, ecology and evolutionary biology

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LO: When did you first know of one another's work?

IA: What I do is very isolated. I work mainly by myself, I don't receive outside support from any groups, and yet, I have found, and Tim referred to it in his presentation just now, that people have found uses for our work for their own agendas and their own groups. For example, there have been some anti-nuclear groups in Japan that have been using my work. It was through a mailing list that I was on for an evacuation trial in Japan. They brought a case against the government to try and evacuate school children and asked if they could use my film A2-B-C as evidence in the trial. I asked the mothers in the trial and they agreed, so this film was submitted as evidence. Among the emails I was getting, somebody asked, "Do you know Tim?", and I was like, "Who's Tim?" I did some research and I realized, "This is Dr. Mousseau!" but they were on a first name basis with him. Where I come from, I would be referring to people only as 'Professor' or 'Doctor' so it's very strange to say, "Oh yeah, Tim, you know…" So, that was where I first heard of him.

TM: Yeah, I was involved with that. How interesting. I first ran into Ian in Germany–Was that this year?

IA: In Germany. We met in March.

TM: In March this year. You know, time follows very strangely since Fukushima. You know, before Fukushima and after, for many of us. Ian and I were both participating in a workshop sponsored by the IPPNW, the International Physicians for the Prevention of Nuclear War, an activist group. They invited a potpourri of folks who were interested in this area or who've been working in this area. Ian was there to document the event as well as to present a showing of his incredible film (*A2-B-C*). The first time I met Ian, he was poking his camera in my face and asking me questions [laughs] for the blog that he was producing, which if you haven't seen, it's worth a good look, by the way. It's a great blog. And then, I saw his film, and at that point I was just tremendously impressed. Having three kids myself, and having interacted with a lot of school children over the years, I was just so incredibly impressed with his ability to capture that emotional state, and for the children to open up in ways that you rarely see on film. It was so honest, so clearly truthful and unscripted, and it was a real insight into how people were feeling, how they were thinking, especially from the children's perspective and also from the mothers'. I knew this was something really special, so I'd been using it in my classes as well. Ian's kindly allowed me to do that, again, to evoke this whole emotional state that the people find themselves in, and in this area. So, I've been following him since then. I had a chance to interact [with him again] at the FCCJ purely by accident just a couple months ago now. (**Figure 1**)

IA: I'm a member of the Foreign Correspondents' Club of Japan, and the moderator for Tim's press conference was suddenly not available to do it anymore. I was having coffee at the FCCJ, and Tim happened to email, asking, "Are you in Japan? I have this press conference." And I said, "I'm sorry, I have work." I had a meeting that day, so I couldn't go. But, the day before his press conference, he was presenting at the International Ornithological Congress in Tokyo. I said I

would like to go to that conference instead, so I went to it. Then, I went to the FCCJ for another meeting, and they said, "Hey, we have this press conference tomorrow and it's about Fukushima, could you please do it." And I said, "I'm sorry, I can't. Is it Tim's conference?" And they said, "Oh you know him!" And I said, "Well yes," and they said, "You've got to do it." And… so I cleared my schedule –

TM: Did you lose any money doing that?

[*General laughter*]

IA: No. I did the press conference, and I've been a member of the press club for ten years, and have never been asked to do that. It was my first conference to moderate.

TM: It was my first press conference.

IA: And it went really well, and the FCCJ posted it on their YouTube channel. It's one of their highest viewed videos.

At the IPPNW conference in March of this year, we were in a church conference center. The money had been provided by this church. Which is fine, but when I got there, I thought, “Huh, this is interesting,” and I wrote my dad, who's an Anglican priest, and I said, "Hey, I'm in a church!" [*General laughter*] Right? It was kind of weird! And one of the things that I think we always need to question is "Where is the money coming from?" to sponsor certain things and

what is that agenda. I've been invited to go Jordan to present the film. My dad is my sounding board, so I asked him, “What do you think about this?” He and I went through it and we looked at the groups and where the money is coming from and what is their agenda. Even for [everything], where is my money coming from to make my films, and where does the money come from to do this conference, I think these are questions we always need to ask.

LO: Tim, what's your view about this?

TM: Yeah, about funding, it's funny. Ian and I have had the same kind of experiences. I basically have for the most part simply prostituted myself to pay for my research by serving as a university administrator for most of my recent career. That was the only way that I could find discretionary funds – funds that were not tied by any political agenda – to support the research. Most of the work that had been done in Chernobyl had been sponsored by the U.S. Department of Energy and tended to be related to radiation measurement or clean-up. But it’s never the sort of work that we'd been doing, and there's a reason for it. I would like to say that time is the only thing I don't have enough of, because money is relatively easy compared to some other things, but finding the right sources of funding has certainly been a challenge.

IA:I think of it as when you take money, you're selling your freedom. There is no free money. It always comes with some attachment. I've been very fortunate until I made *A2-B-C* I had a private sponsor, an individual who said, "I support your filmmaking." It started before my filmmaking in Fukushima. So, I had the freedom to have a chunk of money to make films about things that I felt were important. There were no strings attached. They didn't want to have their name all over

the film. *A2-B-C* was the first film that I made that I did not have that [support] because my sponsor died. This was the first film that I made purely with my own money, but it's not sustainable. It's like I said last night, you can't continue to do this. So what do I do? I'm now prostituting myself by teaching, which I'd said I wouldn't do. [*Laughter*]

TM: Most of us in the room do that.

IA: And I apologize for that, but basically in my experience, and it goes back to an interesting point that you just talked about, in your talk… you said something basically about finding a balance with traveling, and that you would do more research if you had more time. So, how do we do that? The more time I am in my office or classroom, I'm not in the field. What I am is a filmmaker, I make films. I am so honored and grateful for the opportunity to be at these kinds of conferences and to go to film festivals and even to teach, because through teaching, I also think that it helps me learn. It helps when you teach someone to do something, you are solidifying what is in your head. I never think about what I do, and then when I have to explain what I'm doing, it's almost the first time I can truly begin to comprehend what I am doing. I'm grateful for the opportunity, but then what I don't have is more time. There is no more time. So, [when] I'm making a new film, people always say to me, "Oh, we're looking forward to your new film!" and I say, "Okay great! Can I have some support?" "Oh no we don't have any support for you." I feel like I am given this responsibility to continue my work, and very often the people who are forcing that responsibility on me are not the people who are going to be able to help me follow through with that. Do you know what I mean?

TM: I get it. That's the academic's dilemma. That's always the constraint, you know. [*Laughs*] There's always pay back. I think you started off with the right insight. Everything has strings. And so the university gives a salary to teach, but that gives the freedom to do research but we still have to follow through on our obligations and responsibilities.

LO: What does fieldwork mean to each of you?

TM: I think Ian and I have very similar perspectives. It's about discovery for me. It's about exploration and discovery. I got into field biology because I wanted to explore the world or various parts of the world and my personal interest has been wildlife of various sorts or interesting places. So that's what initially motivated the work. How about you?

IA: Well, people have asked me, why do you want make films in Fukushima? And I don't. I don't want to do this work, I don't know where inspiration comes from. But this is not something I want to do, it's something no one wants to do with their life, because I wish that we didn't have to. But we are living in a world now where we must do this. I feel compelled to do it.

TM: Again, I get the same sort of question. Why are you working in Chernobyl, why aren't you working in Fukushima? And my first response is, "Yeah if I could actually choose I would be working on a coral reef in Bali [*general laughter*] or even the Great Barrier Reef." In fact, that's what started me in biology. All my friends go to these nice wonderful places, but I seem to end up in the most radioactive places on the planet just for fun. But it is because it's a question that hasn't been answered, there's clearly a compelling need to address the question. I used to work on

the genetics of sexual behavior in insects. I was very successful at it. Lots of big grants, no problems getting funding, great publications, well cited, but who cares about the sex life of a cricket, really? Come on! I used to spend a lot of time caring about it. Me and ten other people in the world thought it was important. When we started doing the Chernobyl work, it was very clear that other people were interested in what we were doing. I'd never had this before, you know, that regular people would be very interested in knowing what we'd found out. So that really provided the motivation to continue to sustain the interest in finding out more because people want to know answers to these questions. These are important.

IA: How do you know how much of what you're going to do before you do it? Because people ask me, for example, with the film, "how do you know what the film is going to be about?" I don't know what the film is going to be about... People ask, "Have you ever done about crowd funding?" You have to present it to somebody. If I take money from a crowd, or take money from an institution, I must tell them what the film's going to be about – and I don't know. I have to tell them when the film's going to be finished. I don't know. I have to tell them how long it's going to be. I simply do not know. And so I need money to be able to figure some of those things out, but I can't tell you what I'm going to be doing with the money, until I actually do it, so I will need the freedom to do it, to let it be organic.

TM: You know, our approaches are exactly parallel. The secret to our success, so far, and really they are one of reasons we are one of the few groups that are actually working in these areas, is because we've the freedom to be opportunistic. So, in the beginning, nobody knew what to expect. In fact, if you'd read the United Nations report, you'd think that were would be lots of

wildlife, doing really well (Alexakhin et al. 2006). That was encouraging to us originally because we thought, "Let's go study adaptation to radiation." When you get there, you realize that “Oh, maybe I’m won't be able to get to this place, and “Oh by the way, there aren't any animals to study!" So what do you do? You can't make promises exactly right, and you can't promise anyone who's funding about exactly what you're going to be able to do, exactly when you're going to be able to do it. And I treat every visit to both Chernobyl and Fukushima as potentially my last because I never know for sure how I'm going to be able to get in to do a particular project or not. There's always an element of uncertainty because of either the political issues or otherwise. And, so yeah, it's important to be able to be opportunistic.

IA: I've a specific question about your work. At the FCCJ press conference that you gave – I have some quotes here – I was going through them last night and wanted to ask about one. One of the things that you said was related to stress and about how you felt that animals didn't experience stress. [O]ne of the things that the Japanese government is saying is that some of the things that I'm documenting in my film or that we’re seeing in general are stress related, and they're not a direct cause [from] exposure to radiation. One of the things that you'd said was that the fact you felt animals are a great control group, because they didn’t experience psychological stress. I was going to ask you about that, because I feel that animals are affected by the presence or absence of humans, that we affect their environment. I was wondering how you would respond to that. So, if there were animals that had adapted somehow to people being there, and then suddenly all people weren't there as in the case in Chernobyl, I don’t know whether you would describe it as stress or not. Would the animals possibly be affected by the absence or presence of human beings?

TM: It's an important question and the physicists would have something to say about that, Heisenberg's uncertainty principle and all that. The truth is that most animals are negatively affected by the presence of humans. Humans are the stressor, and the absence of humans would provide a less stressful environment for the most part. Now, there are a few commensal critters that rely on humans for handouts that associate with humans, and they're clearly going to be stressed. When I referred to 'stress', though, I was referring to the stress that results from thinking about radiation: psychological stress. That's what I was talking about. I wasn't talking about environmental stresses. Life in the real world is incredibly stressful. In fact, some of the latest literature on radiation in Chernobyl animals shows that the animals studied are about eight times more affected by radiation in Chernobyl *and* their natural environment than they are by radiation in a laboratory setting. When we attribute this increased consequence of radiation to the stresses of evading predators, the stresses of finding food, the stresses of finding a place to survive the winter, the stresses of disease and parasites, the natural world is incredibly stressful. [In the press conference], I was specifically referring to just the [results of the] stress from thinking about radiation because that's been suggested and described as an important cause of human morbidity and human disease. That doesn't apply to most animals. I don't think they think about the radiation. But, humans do think about the radiation, and you capture that in your films. How did you get started down that path, capturing that interesting interaction?

IA: I document people and one of the things that you said in your conference as well is that you're not an activist. You're not a nuclear activist. You're an activist for accurate, independent information. My documentaries are not about Fukushima, and they're not about radiation. They're about people, and about children. All the films that I've done are always about people.

When I went to document Fukushima, I was living in Japan. It was my home, it is my home, and so it was something happening around me. So when [the explosions] happened, I just naturally started to film people. So for me, one of the interesting things about the film or the use of your research, are the questions that people ask about intentions by doing this. It's something that people ask me. I don't really have an intention. I simply am trying to find an answer for myself; it's really for me. And, I think that the way it can be used in the classroom to teach, for research, is what other people can decide, or can figure out – what is the meaning of what I am doing. By working and seeing your research and everyone else's papers, it's helping me to begin to understand what it is that is captured in the work that I'm doing.

But that's it. I don't understand data very well. You [Tim] weren't there yesterday at the Q&A [after the film], but I mentioned about how you had said something about the increased rate of leukemia, around the nuclear power plants and you said it's double but it may only have been like one child – it might be two. That's double, but it's still relatively small. And I know you weren't saying it's insignificant, it was simply that we were talking about the data. But, I think in general when we talk about data, when we talk about what's in the newspaper, in Japanese we say for example, "*Hitorishika*? Only one? Only one increase? What happened? Only one person?" But it's not *hitorishika*, it's *hitorimo*, it's even one more. It's one additional person. To that one person, that's one hundred percent. That's what I was talking about yesterday. For me, it's very much about the human element. That's why I focused more about people, specifically on children, because although they have a voice, we don't listen to them. I don't feel like I'm giving the children a voice, the children have a voice. I'm simply facilitating that to be heard by more people. People have commented and asked how I got those interviews with the children. It is

because I don't think of the children as children, and I certainly don't think of them as my children, I don't have children. I think of them as my brothers and sisters, I think of them as small people. They're just little people. And, if you treat them as people and are not condescending to them, they will speak like people. And I think that the problem with journalists and reporters, particularly for television news, is that they speak down to children and they ask them questions for which they have already decided what the answers should be. And that's why you don't get good interviews with kids.

TM: What I really found evocative in your work is that it really does capture this psychological component independently of everything else, just that awareness and in a period that only a child can have, and the response to this changing environment that you just don't see very often. It was very insightful to me.

LO: Could you elaborate on that in terms of how it might connect to your work? Are you a spokesperson for creatures?

TM: [*chuckles*] Spokesperson for creatures. You know, yeah, everything is connected. I get this question a lot, “does this have any relevance to humans living in the area?” The short answer is "Of course it does!" We're just an animal and in an ecosystem as well, so, these other animals are being impacted in a measurable way, and there's no threshold. Then, of course this has relevance to humans. I'm not sure that it’s similar in a sense that we’re looking for a response to this change, this environmental stress, and in different ways. But it's certain that animals are completely naïve, they're completely unaware of everything else going on, and they're

responding in a very pure way to that environmental change, so in that way they are potentially connected, I suppose.

LO: One of you is often behind the camera. Sometimes, Tim is also behind the camera collecting data, but perhaps in front of television crews as well. You are both mediated, united by the technology that mediates our understanding of science and society through measuring devices like Geiger counters, which are also featured in both of your work. How has technology played a role in managing or producing scientific trust as understood through your work?

IA: If I could first not answer that question, and talk about in front of the camera versus behind the camera, because one of the dangers I think of having my work better known and I would suggest that it's probably true of Tim as well, is that I want my work to be known for my work, and I don't want it to be known necessarily about me. And yet, there are groups in Japan, like on Twitter, if I tweet something about Tim, it's all over the place.

TM: Really? That's scary!

IA: It is scary, because I think that at some point it would be easy to lose sight or lose track of what you're doing. In some ways I just want to make the work and to actually not go out into public. And not actually present it. An example of that is my distributor, who advertises the film as a film about Fukushima through the eyes of an American.

TM: Oooh.

IA: And we really argued about that, because I find that reductive and insulting. This is about children in Fukushima, it's not about a white guy with a camera. When I make another film, I don't want it to be about the guy who made *A2-B-C*. I want it to be independent. I don't want there to be "Oh, it's a film by Ian so it must be okay." It must be independent. How do you feel? I want to be challenged in the same way in each time, and not have other people simply trust me because it's made by me, for example.

TM: Yeah, it's a tricky one. The problem, the difficulty is that in order to get the message of your film across, someone has to be an advocate for it. Somebody has to shout for it. Earlier, I mentioned this National Academy panel that I was on, where leading respected authorities in the world had never heard of our work, and at that point I realized that I had to spend more time on education, on broader impacts, on sharing the message in as many ways as I possibly could, if we were going to make any headway. In our article, my goal is to increase research activity in this sub-discipline, it's kind of a niche. It's clearly something people find important. They want to know the answer to the question: "Are there likely to be some consequences down the road for human populations that are living in these low dose areas? Well, how much? How quickly?" The only way we can get at that question given our current state of knowledge is by having a whole bunch more people start doing research in this general field of radiation ecology. There was nobody advocating for that position, and so that's why I decided to get in front of the camera, as it were, to share that message.

IA: That’s probably one of the places where we're different, because the more well known your work is, then the more access to funding and equipment. But then, the people that I'm accessing for example, are like, "Oh you're the guy who made *A2-B-C*". If those people who are being interviewed come with that knowledge, that feeling, then the interview that they give will be affected. Whereas with maybe with the animals, they're not thinking, "Oh this is Tim, he's come to help us." [*general laughter*] But that is what I feel in my work. I would prefer to interview people who do not know who I am.

LO: What about the technology?

TM: Well, technology. In science, I think it is interesting that what I consider to be the most important part, or the greatest insights that we have generated that are most significant, are the ones involving bird counting, or counting the number spiders and insects. There's no technology, apart from a GPS, which we rely on but do not absolutely need. We could just use the sun and compass, and maybe a watch. But, the most important part of what we're doing are the simple natural history observations that don't require a whole lot of technology. They do require some intimate knowledge of the organisms that are there, and what their behavior might be, but other than that, we don't use a lot of technology. That said, we would love to use a lot more technology, we'd love to use genome sequencing to get at some of the more fundamental questions that are likely to be of broader relevance, but we don't need it to get started.

IA: That's fascinating, because I do not use a tripod, I do not use lighting, I am back to the basics because I'm trying to just get the pure human feelings. I do not think in my case that more

technology would be helpful. It's about going back to the basics. Granted, if I had more equipment, if I had more funding, we would be able to do more and different things. But the core narrative, the core thing that I'm trying to document is not about technology.

LO: There are people using technology in your films, like the Geiger counters, for example.

IA: Sure.

TM: Yeah, you know radiation being what it is, requires that you have a sensor. You have to have the sensor to know where it is. That's what kind of differentiates radiation from all these other environmental stressors. You can't see it, smell it, taste it, feel it; whereas most other environmental effects or changes have some measurable component that doesn't require the sensor. So, yeah, you have to have the Geiger counter to do this kind of work.

IA: But, then how do we interpret that kind of data, because, is there a threshold? What do these numbers mean? People have asked me, why don't you provide some kind of context for what the numbers mean? The truth is that I don't think we really know. I could ask ten different experts and they could give me ten different opinions about what it means. A question came up came up when you [Tim] were giving your paper, about statistics and interpretation. So, where do we start with that? We have the technology, we can see the numbers moving and changing, but then, what does it mean? Tim said a couple of different times, we just don't know. It's still sort of out there, right?

TM: I think there are huge uncertainties and more and more people are coming to recognize this, and only time will tell for the long run.

LO: This concludes this portion of the *taidan*, and we'll open the floor for questions.

Harry Wu: My question is a bit challenging but I'm following Tim's comment on documentary-making. Scientists are often criticized for their ivory tower. They claim themselves to be neutral and more reserved and for not being activists, but perhaps you're exceptional, since you're an activist of accurate and exacting information. For documentary makers, they are often criticised for being too provocative, too naïve, and too passionate about something. I would like to ask both of you – Ian, when you are dealing with scientists, what do you generally see? And same for Tim, when you are working with cameramen, what do you feel about them? Instead of praising each other's work?

TM: Cameramen are fine. Cameramen are the artists, they're the guys trying to capture the visuals. So, I'm very sympathetic to them.

IA: Speaking broadly, not about Tim, I find that a lot of the scientists or doctors that I meet have no emotion. I understand that when you're working with a patient, for example, giving the patient a thyroid exam, to you, it's one of three hundred patients you've got to get through your clinic that day. You don't have time to hold the mother's hand when she's crying, I understand that. But, these are human people and to them it's a very scary and difficult thing that's happening to them. And then you have scientists who are talking about data, like "it's just one more kid". Well, I

don't accept that way of thinking. I agree with people who say, we cannot let our passions and our emotions control our work. But, we also cannot lose our humanness in what we're doing, either. So, I think we need to, each group needs to achieve what is a very delicate balance between being human and looking at data.

LF (Lyle Fearnley): Both of you mentioned and tend to emphasize that in your approach, that you go out there without having an answer in mind. I was curious if you could talk a little bit about a moment in which you changed your mind about something? And also specifically, what are the approaches or techniques that you use to allow yourself to have those moments? Is there a tension between that and the techniques of recording and devices of measurement and measuring and production of data that is important to the end results, or also in the making of the film, maybe, in the sense that collecting the data – is that something that could lead you have those moments of changing your mind – or do you have other techniques in the field to enable you to arrive at these moments?

IA: The biggest thing that changed for me was that before I went to Fukushima, I thought if you believe that it's unsafe and you believe your children are in danger, why don't you just evacuate? I was one of those people. I know you laugh, but it's true, that's really what I felt! It's true, right, just leave, right? So then I go, and I meet these people, and I [realize], "Oh my God, this is a woman whose husband is not supporting her in her effort to protect their children." Maybe they have animals, and these animals are literally their family members and they can evacuate but what are they going to do with their animals? Or they have their in-laws, their parents who are old, and maybe while those parents are healthy the younger generation can leave and the elders

can stay, but what happens when those parents become sick? There is also the issue that this is their family land that they've had for 300 years, with their family graves on it, and they have a very strong tie to their family graves. And, then you have the issue, which is economic. Simply, you are a farmer and you have no savings but what you have is a debt-free farm, and you have paid off all your farming equipment, you have a house, and you can produce your own food. Suddenly, all your land is contaminated, your house is contaminated, and your equipment is contaminated, so absolutely everything you own, is worth nothing. How on earth are you supposed to evacuate? I realized very quickly that it was not as simple as I thought, in my ivory tower in Tokyo.

TM: I had the exactly the same kind of change in perspective. The first visit to Fukushima region, July 2011, we were staying in Koriyama, in a town of about 300,000 in one of the major population centers just south of Fukushima City. At the time, we didn't have very good maps of where the contamination was. We knew where the highest points were, but the rest of Fukushima wasn't well characterized. So we stayed downtown in a regular business hotel, and there were children playing. It was very busy, it looked like nothing was affecting the area and we were loading up the van with our equipment. I put down the Geiger counter on the ground, just for fun, I said, what's it like here? And the damn Geiger counter hit 3-4 microsieverts per hour before we left, which is, for those of you not in the business, a really, really high radiation level for a populated area. Normally, in Chernobyl, they evacuated everybody who was basically above about 1 microsievert per hour, in that ballpark. I was just completely astounded. You look around in this huge city, with all these people living here, it's impossible to conceive of how you could address this massive problem of so many people. And the major issue though, and this is one that

comes up is that, because it's not 20 microsieverts per hour [*exhales*] – It's in this grey area that some folks have suggested, it's not really dangerous. By that, they mean it's this 5% level. You have a 5% increased risk of getting cancer at some point, if you get 100 millisievert exposure. So, people are making decisions about the risks for everybody else. Basically, what they're deciding is how many people are going to die, you know, what's an acceptable level of mortality associated with exposure. A risk analysis the way we deal with anything else, any technological issue in our society. But they're not telling people this. They're not being honest about it in the presentation that "We made a risk analysis, this is the cost we're willing to pay."

But getting back to your question directly – for me, when we first started going, we didn't really think it was very dangerous. Because we were reading these reports [that said] everything's fine, it's very low dose, it's really nothing at all, probably the animals are doing great, I thought there's a threshold. Really, don't believe that LNT [linear no-threshold] stuff. And, then we started collecting data, publishing our first paper, our second paper, and our third paper in 2004. At that point, we had enough data accumulated where we could put regression lines through our scatter plots. At that point, we realised, "Wow, there's no threshold here." Basically, the plot gets noisier, it gets harder to predict that intercept point, but there's no evidence of any drop-off in effect or any change in this relationship. So, there is no threshold, really, that we can detect. Certainly, we can statistically detect effects at this 1 microsievert per hour level in almost all our relationships, and at that point, we went, "Holy, jumpin', what have we been doing to ourselves here?" At that point, we started being more careful about how much exposure we were taking in each of these visits, and what we were subjecting our colleagues to. But, of course, at that point, it was probably too late.

IA: Do you measure your exposure?

TM: The first year or two, we were very careful about measuring total exposure and there were 3-4 years where we weren't very careful and now we're back to being very careful. So yeah, we have some estimates of our cumulative dose. What I can tell you is that there have been health consequences that are directly related to these exposures, which completely surprised us. And so that's provided a little more reality to the whole thing.

LO: Let's take one last question.

RW (Rohan Williams): I have a question for Ian. It was from the audience yesterday and I suspect you guys were talking about it when I ducked out. Someone asked you about these meters that people use and how they may not be taking readings properly because it's not a scientist who was using it, or that it’s not done with a protocol. At the end of that day, that thing may lack precision, and its accuracy may have biases, but it’s still an instrument. What happens to the data? Do they Tweet it, do they post it to a web site that collates it, or are they walking around with it when filming or in their daily lives, looking at what these readings are in real time?

IA: There's all different kinds of things happening, and each case is different. For example, the glass badges the children are wearing, the young children, they feel it's dangerous to put a string about the children's neck as it might catch on something and a small child could be choked by it, so they put it on their backpacks, which you saw in the film. The problem with that is that when

the kids go outside to play at recess, they leave the backpack in the classroom. It's not really giving you an accurate measurement. And it's of external exposure, so it doesn't give you anything of what they're breathing in, dirt and things. And one of the things I was thinking about when you talked about Koriyama and putting the measuring at the ground level, is what we're not talking about is that in many cases is that children are playing on the ground, touching the dirt, putting their hands in their mouth, so it's not really accurate. But specifically about the mothers doing the measuring, yes there are all kinds of different things that are happening. Some of them are using the Safecast monitors with GPS on them and actually helping to map radiation levels in their own area. And then some of them are just measuring and trying to find hot spots in their neighborhood, and particularly along routes particularly where their children are walking to school. And there are groups of PTA fathers who are saying, "Well, the government is not helping us, so we ourselves are going to expose ourselves to radiation and try to decontaminate the area." What that means though, is that they're collecting dirt and because that dirt is on your property, that's your belonging. In many cases, they are actually storing radioactive dirt on their own property because there’s nowhere to put it.

RW: So are there any control populations for these personal Geiger counters? Has anyone recruited families in Tokyo to do exactly the same measurements?

IA: Well you know the thing about Safecast is that they're not only having data in Fukushima but literally all over the world, so what they're trying to do is create a map of what is the natural radiation level in cities so that, god forbid, should something happen again, we would have that data. So yes, speaking specifically about Japan, yes there is data... I'm not an advocate for

Safecast I'm just using that as one example. It’s a citizen's group, a non-profit organization, I believe. It's a group of guys who go out together and they crowd source ways to easily give the technology to people to make Geiger counters themselves. You can make them yourselves and there's GPS in it, and you can take it out and upload your data to the website. Maybe you can speak more about them.

TM: I built two of them. Yeah it's a Geiger counter with a GPS and a data-logger built into it, that you plug it into the USB port of your computer and it automatically uploads onto the database and to the Google maps.

RW: Sounds like a citizen science project.

TM: It's a citizen's science project; they put it on the mail delivery trucks, so they basically mapped out most of Japan and a few other places. I've used it in Chernobyl. It's just a first level of survey but it does gives you an idea of what the background levels are like in various places.

IA: And the question about Tweeting the information, I think, is very important because as in any country, the usage of Internet is lower in the countryside versus, say, in Tokyo. There are many mothers that I met who had never used the Internet let alone Twitter or Facebook. As a result, after 3.11 [three eleven], they were using Internet for the first time, they were using Twitter and Facebook, and they were forming these grassroots organization amongst themselves to transfer data. So, yes, they are using new technologies in ways to share information.

TM: But to get to close to your point, the reason for keeping these things available is that the environment is very heterogeneous. There are hot spots here and there, the way that they cleaned up the areas gives you the impression that it's clean but really they just stripped the dirt around the roadsides or in the playground. Fifty feet away there will be a hot spot that might be a thousand times more radioactive that if a kid were to stumble into…

RW: But to get back at the data, most data analysis and statistical methods don't deal well with heterogenetity, although this is becoming more of a focus in statistical research.

TM: You know the paper by Ian Fairlie that I mentioned earlier about the leukemia rates around nuclear power plants. His major conclusion is that it's not the average rates that are important, it's these spikes that are important.

IA: Absolutely. And what we're finding, it was in the film as well, they're putting these radiation-monitoring posts in areas that have been decontaminated. But of course they're going to be low, then. It's counter-intuitive, I think.

LO: Thank you very much. In closing, today we brought two people who are really entrenched in different kinds of fieldwork, here to Singapore, and to the indoors. Ian and Tim, we've asked you to share some insights about the practical matters of doing this work in the natural and social world. I think we've learned quite a lot, and we can hopefully continue to have a sustained dialogue. Thank you very much for your time and [turning to audience] for everyone's time.

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