Interview of two of the OneZoom trustees, James Rosindell and Yan Wong, by Daniel Cressey, a reporter for *Nature* in London

The full unedited answers to all questions are shown below.
For the finished and edited piece go to blogs.nature.com.

Daniel: *Why did you start this project off? Was there a particular moment or event that inspired you to create OneZoom?*

James: OneZoom can be traced back to a particular moment in 2011. It's a rather nice anecdote that the idea first struck me whilst in discussion with Luke Harmon (now at the University of Idaho) shortly after walking around Darwin's "thinking path" at Down House. Luke is now one of the trustees of the newly formed OneZoom charity.

Daniel: *What are you looking to do now, with the crowdfunding? How will more money allow you to develop the project?*

Both: thanks largely to projects like the Open Tree of Life, we've now got the entire tree of life with over 2.1 million species, right now in our database. We've also already developed visualization methods that would make it easy to navigate the tree seamlessly. What we don't have yet is software capable of dealing with such large trees on a normal PC, let alone a mobile phone. For this reason, our website currently only reveals a fraction of what is on our database. We are sure that we can produce a browsable tree of all life for mobile devices, and much more, using OneZoom as a foundation. This will take a lot more work and needs help from professional developers, and so far we've been working essentially in our spare time.

James: it has proved tricky to obtain funding from traditional sources for this unusual project, we've had to think outside the box, and after a lot of thought this 'crowdfunding' idea seemed like the best option.

Both: We call it 'crowdfunding', but actually OneZoom is not like most other crowdfunding campaigns. There isn't a start and an end. It's more about sustaining and improving this project as a public resource in the long term. Also, no two rewards for contributing are the same; each species on our tree of life can have only one sponsor (the sponsor's name is unobtrusively printed around the outside of the species 'leaf'). Every time someone sponsors a leaf, more of the tree will be added. We have calculated that by the time the size of the tree causes technical problems, we will have the funding to overcome them, so that

eventually the complete tree can be revealed. We considered using popular crowdfunding platforms for OneZoom, but in the end decided the only way to do what we wanted was to build a new system from scratch ourselves. This included such things as developing a measurement of popularity for all species of life on earth, so that we could decide which leaves of the tree were appropriate for which level of donation.

Yan: Another way in which our project differs is the community aspect. In many crowdfunding projects, if someone pays something in, they get the primary reward. In the case of OneZoom, the donors do get the reward of their name appearing on the tree, but since everyone in the world can view the tree, in a sense, everyone in the world benefits from the investment. In fact, in the first 3 days, leaves of the tree have been sponsored by people from the UK, US, Switzerland, Mexico, Italy, France the Netherlands, and Canada.

James: we wanted our supporters to feel a sense of ownership of the OneZoom tree of life because their name is stamped on it. The species you choose to sponsor is quite personal and that enhances the community feeling without detracting from the underlying scientific core of the project. It is great to see that people have already sponsored leaves on the tree as a gift, inspired by the birds that come into their garden, a former study organism, or just the species they most like.

Daniel: What do you think this tool adds to existing trees of life that are available?

Yan: until recently, most large trees of life were either not to the species level or specific studies concerning only particular groups. This has changed with the advent of the Open Tree of Life effort to collate and synthesize phylogenetic data for all known species - we have been active contributors to that effort. Our tree builds heavily on the Open Tree of Life, but includes a number of additional studies that help resolve uncertain areas of the tree, and add carefully considered date estimates to key areas.

James: OneZoom isn't just about the raw data behind the tree of life. The goal of making the latest science easy and fun to explore for anyone is equally important for us. In fact, the ambition of the project is broader than just the tree of life, we see the tree as the most natural 'indexing system' on which to pin rich data about natural history. For example we're including stunning images from the Encyclopedia of Life, mappings to Wikidata through to Wikipedia in any language, and (for some parts of the tree) conservation status from the International Union for Conservation of Nature (IUCN).

Daniel: Obviously we'll have images etc on the site, but can you give us your

brief description of OneZoom? If you had to explain it to someone on the phone, or to someone who was blind, how would you do that?

James: we're aiming to do for the living world what online mapping software like Google Earth has done for the physical world. The key concept behind "OneZoom" is that a huge amount of information can be placed on *one* page and all you have to do is pan and *zoom* to access that. By visualizing large evolutionary trees as a branching fractal, mindboggling quantities of data can be made easy and intuitive to access. Just as one might zoom into a country and then a town from a map of the globe, one could zoom into vertebrates and then, say, bats on the tree of life. Think of it as a digital zoo, natural history museum, aquarium and botanical gardens rolled into one. In fact, our 'crowdfunding' campaign is rather like the digital equivalent of sponsoring an animal at the zoo.

Daniel: Is this a tool for learning, or a work to inspire? Are you trying to make something beautiful or true?

Both: we don't see that there is a dichotomy between being beautiful or true, we're driven by presenting what is currently our best guess at the truth in a beautiful manner. OneZoom will serve different purposes for different people; it may help them with teaching and learning, or inspire them by providing a new medium that visibly captures the huge variety of life that exists on earth, and the way in which it's all connected through evolution.

Daniel: To play devil's advocate - isn't everyone familiar with the tree of life these days? Why do you feel there's a need for a tool like this?

Both: People are familiar with the *concept* of the tree of life but that's not the same as actually having the whole tree, down to the species level, in your pocket. In an analogy, if maps were like the tree of life, what's currently available is like a rough sketch of the whole globe, with some detailed drawings of certain areas. We don't yet have a "Google Earth", or anything like it - that is the goal of OneZoom.

Daniel: It seems there's a lot of redrawing of the tree of life at the moment. EG: http://www.nature.com/articles/nmicrobiol201656. How do you choose the shape of your tree, and how will you update it as new research emerges?

James: If by 'redrawing' you are referring to the visual representation of a tree, there are many different ways to do this. In fact, even within OneZoom there are four different views through which one can see the same data - and we would like to create more. There are other visualizations of the tree of life drawn by hand, which gives a lot of freedom to make a clear and visually attractive diagram and highlight important facts. The disadvantage of human-drawn illustrations is that

they can only be made for small trees and everything will need redrawing when the science is updated. In other cases tree viewers are more like graphs produced by a computer: simple to update, but probably only comfortable to read for an expert. The OneZoom viewer is useful because although it is easy to explore and visually appealing, it is also automatically generated - an essential combination for what we set out to achieve.

Yan: As for the topology of the tree - the order of branching and so forth - we have semi-automated pipelines in place to keep our tree up to date. They tie together several preexisting resources which themselves are being constantly maintained. For example, the Open Tree of Life release 5 came out on 7th April - our pipeline was able to incorporate it and produce a new tree in time for our release less than a month later. However, some important areas of the tree still require hand curation: this is done as new studies are released.

Yan: One current area of change is in the taxonomy of bacteria - and the identification of many previously unknown areas of the tree of life using single cell genome sequencing. This is one of the reasons that we omit eubacteria from the current tree. Another reason to omit bacteria is because they undergo extensive horizontal gene transfer, meaning that different parts of their genomes show different phylogenies. That means a single evolutionary tree is probably an oversimplification of their relationships. It could be argued that this also applies to eukaryotes: different pieces of DNA can have different histories (incidentally, that's something we talk about a lot in the new edition of the Ancestor's Tale). Nevertheless, I think it's reasonable to say that a single tree is an excellent (but not perfect) guide to the relationships between species, just as a physical map is an excellent (but not perfect) guide to a geographical area. We can use a single branching structure to navigate around the tree of life, just as we would drive from London to Oxford using a simple road map, not a detailed satellite image.

Yan: Going back to updating the information on OneZoom, there are other components which are updated automatically too. I've been one of the main public contributors to the Encyclopedia of Life (EoL) codebase - for example, I've been responsible for more than doubling the number of images on their site. That helps users of EoL but also provides reusable images for use in OneZoom. Moreover, if someone crops an image or rates its quality on EoL, that automatically filters down into OneZoom. Another automated feature of the tree is our 'popularity' measure, which is based on visits and edits to Wikipedia pages. If there is a sustained increase in interest about a particular taxa on Wikipedia, this influences the prominence (and price) of that leaf in the crowdfunding part of OneZoom.

Daniel: *How does this tie in with the Ancestor's Tale? How did you come to be involved in the rerelease of that? Was the book something you were familiar with*

/ inspired by yourself?

James: I have known Yan for more than 10 years, as both a friend and a co-author. I met him after the publication of first edition of the Ancestor's Tale, when he was a lecturer and I was a PhD student at the University of Leeds. I was a fan of the book, but at that time my research was much more focused around ecology than evolution. I later went on to develop the OneZoom software and Yan independently took on an extensively update of the Ancestor's Tale. It was good fortune that I mentioned the OneZoom project to him, which then turned out to be such a perfect fit to the structure of the revised book. As a result, we collaborated extremely closely on the production of a new version of OneZoom - a version that could also be used as the core of the Ancestor's Tale website and which has provided some of the main imagery in the new edition of the book, including on the front cover of the UK edition.

Yan: When James first mentioned OneZoom to me in a phone call, I was in the middle of revising *The Ancestor's Tale*. I didn't really make the connection between the visuals he was talking about and the process of updating the book with the latest science. But after chatting for a bit, and a couple of meetings, it became clear that the combination of visual attractiveness with potential coverage of the entire tree of life, meant OneZoom trees would be a great addition to the book - especially as the book makes an attempt to distill the evolution of all life on earth. As part of the preparation for the new visual design of the book, I looked in detail at around 100 phylogenetic studies that concern the lineage leading from humans back to the origin of life. Synthesising these studies into a single tree was necessary to give rigour to the 'pilgrimage to the dawn of life' that we undergo in *The Ancestor's Tale*, but also formed the backbone for the tree than is currently being used in OneZoom.

Yan: I'm very pleased with how everything has turned out. It's been mutually beneficial for all concerned, and now along with James Rosindell and Luke Harmon, I am one of the three founding trustees of the OneZoom charity. I'm really excited by the direction this is all going.

Both: We hope that these answers are helpful, if you need any further information, please don't hesitate to ask by e-mail or phone