Best in class

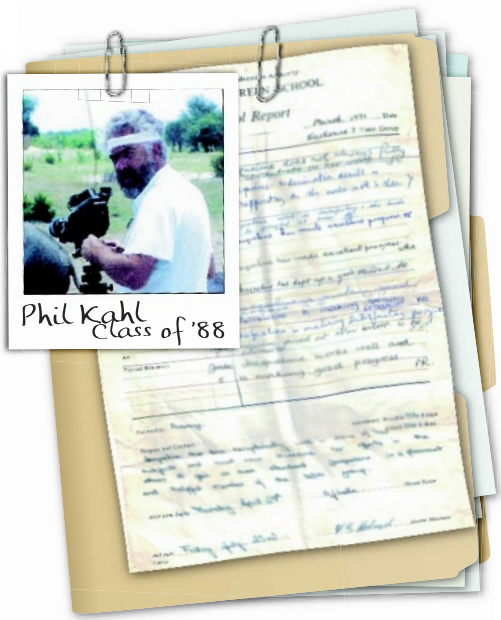
What is it like to be labelled a genius? **Kendall Powell** follows the paths of four MacArthur Fellows — and finds they lead to rutting elephant bulls, climate-change champions, hybrid sunflowers and robotic hands.

ARTWORK BY W. FERNANDES

In what is perhaps the most secretive talent contest ever, the MacArthur Foundation recognizes and rewards people who demonstrate exceptional creativity. Just this week, the foundation awarded 25 disbelieving recipients in the arts, humanities and sciences with its illustrious MacArthur Fellowships or, as the media has labelled them, 'genius grants'.

The fellowships don't have quite the intellectual and financial cachet of a 10-million Swedish krona (US$1.5-million) Nobel prize. But they do bring with them the label of 'genius', and half a million dollars to spend however the recipient decides. Now in its 28th year, the programme has awarded more than $360 million to 781 US citizens and residents aged from 18 to 82.

The MacArthur Foundation, based in Chicago, Illinois, does not give the awards for specific accomplishments. Through a highly secretive nomination process — files are allowed to 'ripen' over several years — the programme identifies extremely talented and creative people who are likely to make breakthroughs and make a lasting contribution to society. "We get the best information we can and consult with the wisest people we know," says Mark Fitzsimmons, associate director of the MacArthur Fellows programme and the programme's in-house scientist. "We think it is a good investment to build up the portfolio of young people who can change their field significantly."



It is also an investment with no guaranteed return: the foundation makes no attempt to measure the productivity of fellows or even what career path they follow. So do the geniuses go on to scale new intellectual heights, or do they struggle with the weight of expectation? *Nature* catches up with four individuals who got 'the call' 1, 5, 10 and 20 years ago and who have used their awards to push forward the frontiers of science.

Class of 1988: Philip Kahl

When Philip Kahl won a MacArthur award in 1988, he was already known as a zoologist who followed his own path. He had spent 35 years studying bird behaviour and he had done it all as a freelancer.

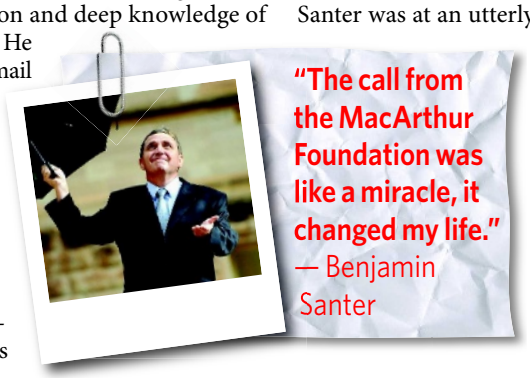
Even though colleagues pressured him to settle into a 'real job', Kahl had pieced together grants from the National Science Foundation, National Geographic and the National Audubon Society to travel to exotic

field sites. He also funded his work by selling his wildlife photography, including a 1969 *National Geographic* cover of an elephant in the Kenyan savannah. "I was having a helluva lot more fun than if I had been teaching at a university," says Kahl, now 73, from his home in Sedona, Arizona.

With the MacArthur money, Kahl's income "quadrupled overnight". Through investment and simple living, his fellowship (US$320,000 in 1988) has grown into an endowment that has largely sustained him and his work ever since. It also gave him the opportunity to switch his studies to the elephants he had been photographing.

"The birds were great and very photogenic — but you can't get attached to birds, they are too reptilian," he says. "Elephants you can really grow to love and still stay objective." Kahl says that no one else would have given him a grant to study a topic that, on paper at least, he knew little about. He used some of the money to spend six seasons in the 1990s studying African elephants' visual communication displays in Zimbabwe's Hwange National Park.

Since then, Kahl has been working at home analysing 225 hours of digital videotape frame by frame, and writing a book that catalogues the 100 or so visual displays elephants exhibit in the wild. He does not toil in obscurity. Elephant researchers around the world recognize his extreme dedication and deep knowledge of elephant displays. He collaborates by e-mail and phone and because he no longer travels, colleagues go to visit him and his library of 3,800 scholarly papers on elephants in about a dozen filing cabinets in his home office.



"The call from the MacArthur Foundation was like a miracle, it changed my life." — Benjamin Santer

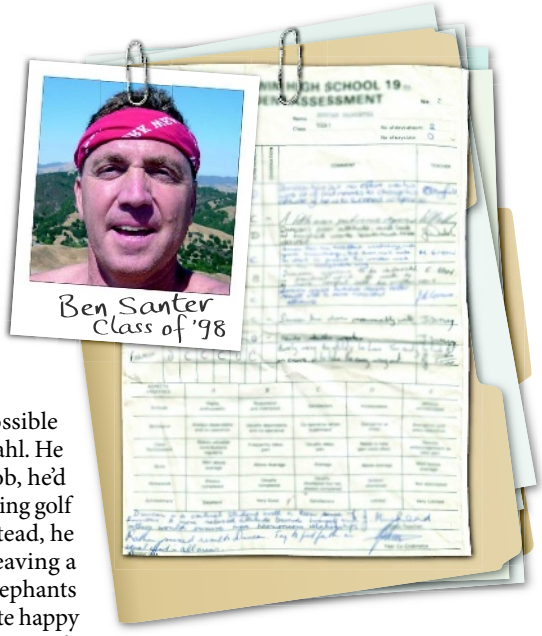
B. EDWARDS/THE ADVERTISER

"I can only take a week at a time with Phil," says Bob Dale, who studies animal behaviour at Butler University and the Indianapolis Zoo in Indiana. "Because it's breakfast, then work on elephants, lunch, work on elephants, dinner, more elephants."

This focus has helped Kahl make observations about the animals that had been missed before. He discovered that 'rutting' African musth bulls can be identified by a wrinkle about two-thirds of the way down their trunks. He also documented how only older musth bulls mate during the peak rainy season; younger bulls must wait until the off season[1]. His observations of these and other displays are valuable for conservationists and zookeepers who want to better understand elephants in the wild and in captivity. (Kahl makes no secret that he identifies with these testosterone-driven males — his e-mail moniker is 'musthbull').

"Phil has no time for the pretensions of the academic society," says Dale. "But he admires an intellect wherever he finds it."

"Many people don't think it's possible to be a freelance researcher," says Kahl. He says that if he had ever got a real job, he'd most likely be retired now and "playing golf or some other useless pursuit". Instead, he works everyday with the goal of leaving a legacy of some knowledge about elephants that will benefit elephants. "I'm quite happy I never got a job. A lot of people who get the fellowships don't do diddly, they spend the money on a house or something. I would like to think I did a lot more than diddly. I just hope I don't kick off before the book is done."



Class of 1998: Benjamin Santer

Benjamin Santer listens to National Public Radio (NPR) on his morning drive to work. And every day, when the announcer says, "Support for NPR is provided by the John D. and Catherine T. MacArthur Foundation," he lets out a little "Woohoo!" Ten years ago, Santer was at an utterly gloomy point, both professionally and personally. The call from the MacArthur Foundation, "was like a miracle, it changed my life", he says.

Santer was in the middle of a bitter legal fight for custody of his four-year-old son and the fees were forcing him into debt. To remain near his son, he was seriously considering resigning from the Lawrence Livermore National Laboratory in California, where he did statistical analysis of climate models.

He was also on the stand at work. He had spent the past two years defending a single sentence that he had penned in the 1995 Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report. Those 12 historic words — "The balance of evidence suggests a discernible human influence on global climate" — became one of the report's major conclusions and unleashed a firestorm around Santer, including calls for his dismissal and editorials in national papers denouncing his science. Energy, transportation and industrial producers of greenhouse gases were keen to avoid blame and emissions curbs.

Although 35 contributors agreed to the wording, Santer was singled out because he was the lead author of the relevant chapter and much of his own research had helped to build the case that some global warming must be attributed to human activities. One of his key studies showed that an anthropogenic 'fingerprint' on climate change predicted by computer models could be detected in weather-balloon data[2], and was cited as "the most convincing demonstration yet" of a human contribution to changing global air temperatures[3].

"Every day I was getting up and putting on this battle armour," recalls Santer. "The recognition that the MacArthur brought showed me that I wasn't alone, that there were others who thought this battle to preserve the integrity of science against these powerful interests was worth fighting." The award money allowed him to pay his legal fees, refocus his energy on science and helped secure a major grant from the Department of Energy to pursue his academic studies. (In 1999, he won custody of his son.) Santer says that the MacArthur prestige also generated its own pressure that has followed him for the rest of his career. "People expect you to do extraordinary things and for pearls of wisdom to come out every time you open your mouth," he says.

Santer went on to show that the human fingerprint was evident in many other parts of the climate system, such as atmospheric water vapour, the height of the tropopause (the upper limit of the weather-containing layer of atmosphere) and ocean surface temperatures in regions where hurricanes form.

He and his colleagues also tackled another of the field's controversies — why a satellite data

set developed at the University of Alabama in Huntsville showed cooling temperatures in the atmosphere in the tropics, whereas computer models invariably predicted warming in response to greenhouse gases. The apparent discrepancy was a hot issue for more than a decade because it allowed climate-change sceptics to question the validity of the various climate models.

In 2005, scientists at Remote Sensing Systems in Santa Rosa, California, found that the cooling results were due to an error in correcting the Alabama data for the effects of satellite orbital drift and created a new data set that was adjusted correctly. Led by Santer, a large team including many high-profile climate scientists, then showed that the new data set was in good agreement with computer models[4].

Only the most extreme sceptics now doubt that humans have contributed to the global climate. "I have felt the responsibility to continue to do science that helps us understand the magnitude of the problem," says Santer, who has continued to contribute to subsequent IPCC reports.

Karl Taylor, a climate scientist and long-time collaborator with Santer at Lawrence Livermore, says that Santer's 'genius' lies in the ability to coordinate group efforts to address important questions. "He's a driver of work and he has the confidence of the scientific community. When he asks, people are willing to jump in and help," he says.

Like most other people awarded with a MacArthur fellowship, Santer is uncomfortable with the label of 'genius'. "I don't think of myself as a genius," he says. "If I ever develop any kind of ego or maniacal characteristics, my friends and family should feel free to take the nearest blunt object and whack me on the head."

Encouraging the next generation's creativity, Rieseberg paints with his son Mendel, named after the geneticist.

M. TSENG

Class of 2003: Loren Rieseberg

Loren Rieseberg isn't a science superstar. He has no fancy educational pedigree. He doesn't exhibit eccentricities or ego. "On the outside, he is exceedingly calm, very soft-spoken, and kind," says Gerry Gastony, a plant systematist working with Rieseberg at Indiana University in Bloomington. "All that belies the intensity within. He has a laser-like focus."

As an undergraduate, Rieseberg attended Southern Adventist University in Collegedale, Tennessee, where the teaching of evolution was banned. To get around the restrictions, the biology department taught a class called 'speciation' because as Rieseberg puts it, even Bible college types "don't mind a little micro-evolution".

Captivated by the subject, Rieseberg pursued a PhD in plant speciation at Washington State University in Pullman. "I was canny enough to realize even at that early stage that grant funding would be easier if I was working on a wild relative of a crop plant — and sunflowers are the one of very few crop plants to be domesticated in North America," says Rieseberg. "Plus, I like the way they look."

Rieseberg turned down posts at Harvard University in Cambridge and at the University of Michigan in Ann Arbor for a job at Rancho Santa Ana Botanic Garden in Claremont, California, where, he says "there were no committees to sit on". It was there in the early 1990s that he started the work that most likely opened his MacArthur file, showing that new species of sunflowers can arise from hybridization.

Hybrids are often considered an evolutionary dead-end, because they tend to have low or no fertility: think mules, the generally sterile offspring of male donkeys and female horses. Rieseberg investigated how new, viable species could arise by crossing together two US sunflower species to make experimental hybrids and then using nearly 200 genetic markers to roughly map their genomes. The work showed that the greenhouse-made hybrids had a similar genetic make-up to an ancient, natural sunflower hybrid species, suggesting that selection rather than chance determines which genetic combinations survive as hybrid species[5].

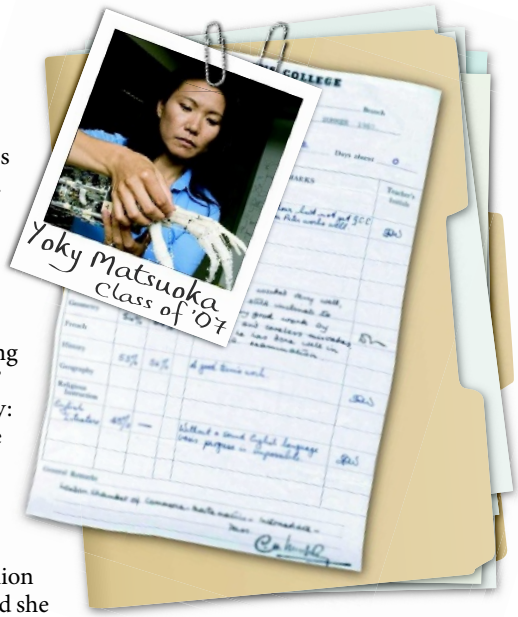
N. KANE

The genetic mapping was a technical tour de force, taking almost 8 years and 100,000 manual polymerase chain reactions. And the study changed the way that botanists and zoologists think about hybridization, says Jeannette Whitton, who was a postdoc with Rieseberg and is now an evolutionary biologist at University of British Columbia in Vancouver. "When you form a hybrid, yes, the first generation's genome is 50–50 between the parental species. But after that, all bets are off — selection pulls advantageous genes through to the following generations and disadvantageous genes get left behind," says Whitton

Rieseberg says that winning the MacArthur fellowship "has made everything easier". He says the biggest impact was in greasing the wheels for the next grants — a comment repeated by other winners. It helped him expand his group, which at around 20 people is arguably the largest plant evolutionary biology lab in North America; in the five years since his MacArthur fellowship, Reiseberg has published 50 original research papers. The influx of cash allowed Rieseberg to maintain his laboratory at Indiana and served as a 'piggybank' to set up another at the University of British Columbia, which is close to where he grew up.

Since the MacArthur award, Rieseberg and his group have solved a long-running debate by showing that sunflowers were first domesticated on the east coast of the United States rather than in Mexico, as some had thought. They also showed that introducing a genetic modification for pest resistance is highly advantageous and likely to spread from crop sunflowers to wild relatives[6].

Rieseberg thinks that the aura surrounding the MacArthur award, rather than the money itself, has made the biggest difference to him in his career. He suspects that the MacArthur Foundation earned its reputation by selecting people from all ages and disciplines and by rewarding people early in their careers. "There are a handful of MacArthur Fellows who are truly head and shoulders above everyone in their field," he says. "But a lot more of us are lucky."



M. LEVIN, UNIV. WASHINGTON PHOTOGRAPHY

Class of 2007: Yoky Matsuoka

All the MacArthur award recipients remember the moment they got the call. When neuroscientist Yoky Matsuoka picked up the phone last September, she assumed the caller was a prankster. "I'm going to tell you something very shocking," said the voice. "Are you sitting down? If you are holding anything precious, like a baby, please put it down."

Matsuoka was indeed holding a baby: she'd given birth eight days earlier. The caller, programme director Daniel Socolow, promised to try again in half an hour. When he did, he told her she had been named a MacArthur Foundation Fellow, that she would receive half a million dollars with no further obligation and did she have any questions? "I'll never forget in my life how it happened," says Matsuoka. "And one year later, it still doesn't feel real."

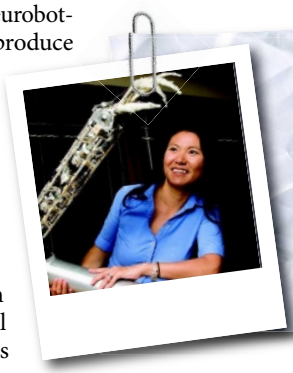
For Matsuoka, who works in robotics at the University of Washington in Seattle, the sum of money could be dwarfed by larger research budgets. "If I just let it sit, it could easily get absorbed into daily things," she says. Instead, Matsuoka has spent the past year pondering how to do something special with her fellowship. "In academic life, it's more about buying time than anything else," she says. And time is at a premium for this 37-year-old whose stated lab and life motto is 'work hard, play hard'.

While in graduate school at the Massachusetts Institute of Technology in Cambridge, Matsuoka became frustrated by the lack of neuroscience in the field of robotics and went on to combine the two in the emerging field called neurobotics. Her laboratory's main goal is to produce the Anatomically Correct Testbed Hand — a prosthetic that resembles and functions like a human hand, including synthetic parts for the bones, tendons, muscles and skin. It would be controlled by the same brain signals that control a natural hand. The aim is to provide rehabilitation and assistance to people with disabilities, and to understand how all the moving parts and neural signals generate such dexterity.

So far, Matsuoka has developed a robotic hand with three of the fingers moved by several motors, representing the muscles that give the human finger its many ranges of motion[7]. Current prosthetics, by contrast, typically offer only one range of motion, opening and closing the fingers. Her group has also tested whether 'molecular wires', polymers designed to conduct electricity across cell membranes, can be inserted into neuron membranes to connect a silicon prosthesis directly to existing nerve cells[8]. The team has succeeded in artificial cell membranes but has yet to translate their findings to real neurons.

"Yoky can do pretty much whatever she wants," says Matt O'Donnell, the dean of engineering who helped recruit Matsuoka to the University of Washington in 2006. He says the synthesis of living tissue engineering with non-biological components in the future is likely to overtake a purely robotic project such as the testbed hand, but that if anyone can do this type of synthesis, it's Matsuoka.

Fitzsimmons says that, like many recipients, Matsuoka was chosen because there was evidence, including testimony from her peers, of her creativity and diligence. She was selected "with the confidence that she can and will make important strides in whatever direction she pursues", he says.



"It's time for me to be disseminating what I did wrong and what I did right to those in their teens and twenties."
— Yoky Matsuoka

M. LEVIN, UNIV. WASHINGTON PHOTOGRAPHY

Since receiving the call, Matsuoka has decided to use the MacArthur money to make a more immediate difference in the lives of people with disabilities. Her inspiration was a man she had met about five years ago who complained that the umbrella attachment for his wheelchair only allowed for a vertical position, whereas rain comes down in all directions. She immediately recognized this as a simple engineering problem — one easily solved by undergraduate or graduate students. She figured there must be many such ways that engineering expertise could improve the quality of life for people with disabilities, but how would she organize such an effort on top of her already demanding duties?

Enter Rayna Liekweg, a former manager for IBM with a background in mathematics, who had spent the past decade raising her children in the Seattle suburb of Kirkland. Liekweg read about Matsuoka being tapped as a MacArthur Fellow in the newspaper and, fascinated by her neurobotic work, cold-called her to see if there was a way she could help as a volunteer. "There is a whole community of women out there not unlike me," says Liekweg. "We are college-educated, have good skills and are looking for something meaningful and intellectually challenging to contribute to."

Matsuoka is in the process of forming a non-profit organization to draw on this community of women, making them into project managers who would connect a problem encountered by people with disabilities with engineering students who could build solutions. As a mother of three children under three-years-old, Matsuoka says she is passionate about helping and encouraging women who are balancing work and family or who gave up their careers.

She also wants to change the image of science and maths for young girls so that being captain of the National Science Bowl team becomes as hip as being captain of the girls' soccer team. "Now that I'm in my thirties, it's time for me to be disseminating what I did wrong and what I did right to those in their teens and twenties."

Matsuoka admits that she was worried at first about getting stuck with the label 'genius' and how it might fuel jealousy. She had heard the sniping comments colleagues made behind the back of a researcher who had won another prestigious award. "But after the first three months I let that go. People are going to talk. I have to do the productive things I can do because of it. Then they can say, 'Maybe she's not a genius, but at least she's done something with it." ■

Kendall Powell is a freelance science writer based in Broomfield, Colorado.

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