

Strange & Beautiful

## Mystery fairy circles defy explanation

**The Namibia desert is decorated by one of nature's greatest enigmas, a huge pattern of thousands of mysterious circles**



**Presented by  
Jane Palmer**

Viewed from the skies, the Namibian desert looks like the surface of a wild and desolate planet. There are no obvious plants, and thousands of tiny craters dot the red barren earth. But zoom in a little closer and a different picture emerges: patches of green appear, along with the occasional tree, and, eventually, perfect rings of tall, sometimes lush, grass come into focus, each one enclosing a plate of bare-hollowed out earth.

These grass-ringed patches are the fairy circles of Namibia. For centuries they've entranced the local bushmen, the Himba. One oral myth says the circles are the footprints of the gods; another that a dragon living beneath the earth's crust breathes fiery bubbles which, when they hit the surface, burn the vegetation into the near-perfect circles.

But the circles haven't just confused the Himba. Despite decades of investigation, and a multitude of theories, scientists still haven't come up with a definitive explanation for their existence. To this day, the circles remain one of nature's greatest mysteries.

### **A thousand unblinking eyes**

Perhaps the fairy circles wouldn't have been able to guard their secrets so successfully if they hadn't been so concentrated in a region referred to as "The land God made in anger." The circles occur in millions in a band where the arid grasslands transition to desert, a 1,800km-long strip extending southward from Angola to the Northwestern Cape province of South Africa. Most of them, however, flank the red sands of the Namib desert, a remote and harsh environment.



The circles appear to be regularly spaced (credit: Stephan Getzin)

Scattered across the landscape, never overlapping, the circles gaze silently up at the sun like a thousand unblinking eyes, oblivious to the harshness of their surroundings. A tall ring of grass surrounds the barren centres, which can measure between two and 20 metres in diameter. The lush periphery of each dish stands at knee height, dwarfing the scrubby grasses between the circles, seemingly standing guard to protect them from incoming vegetation.



*There is a tremendous sense of excitement that there is something really interesting going on*

“There are a few key things that any science theory has to explain about fairy circles,” says Michael Cramer, a plant physiologist at the University of Cape Town, South Africa. “Why are they circular and barren and why are they regularly spaced from each other?”

But since the 1970s, when researchers first started investigating the phenomenon, no single theory has yet managed to do that. At least not to the satisfaction of the scientific community.

But this failure is not for want of trying, or desire.

“There is a tremendous sense of excitement that there is something really interesting going on and we want to know what that is,” says Professor Don Cowan, director of the Centre for Microbial Ecology and Genomics at the University of Pretoria, South Africa. “It is a desire to understand the system. What is going there? What is happening?”

### **Fairies run rings around scientists**

“They are really neat places, these little clean patches,” says Walter Tschinkel, a biologist at Florida State University. “They are like little satellite dishes.” When Tschinkel, the biologist from Florida, first saw the fairy circles on a visit to the NamibRand Nature Reserve in southwestern Namibia, he knew right away what was causing them. “I looked at them and thought ‘this has to be termites,’” Tschinkel says. “It is the sort of things termites do.”

Tschinkel dug for termites in one or two circles and returned in 2007 to investigate, and hopefully prove, his hypothesis. “It took us about three days to establish, without a doubt, that termites were absolutely nothing to do with this,” Tschinkel says.

Tschinkel’s theory proved to be just one of the many to hit the Namibian dust. Scientists have ruled out poisoning from toxic indigenous plants, milk bushes that produce toxic latex, and also contamination from radioactive materials. They have also rejected the idea that the ostriches created the circles by bathing in the dust.



Ostriches were once thought to create the fairy circles (credit: Frank Vassen CCby2.0)

Some theories are still holding strong though, and Cowan jokes that each scientist sees the solution in terms of their own particular area of expertise: the insect biologists think the circles are created by ants or termites, the plant physiologists think it's grasses, and the chemists think it's gases. Cowan, a microbial ecologist, proves no exception.

"Once we saw them, we immediately thought, 'it has got to be microbial ecology,'" Cowan says, meaning, in layman's terms, that means he believes that microorganisms have been killing the plants inside the circle.

The fact that the circles are round, start off small and grow large is entirely compatible with the presence of a pathogenic organism, such as a fungus, Cowan says. Fungal strands, or mycelium, would spread outward radially, infecting the roots of plants and causing them to die. Once the fungus establishes itself in the circle it infects new grass seeds preventing them from growing, creating the barren interior.

"It is just a hypothesis," Cowan says. But it's more compatible with the evidence than many other theories, he adds.



*It is like panning for gold. Once in a while you find a little flake or a nugget and sometimes it is fool's gold.*

Another theory is closer to the folklore; a team of chemists from the University of Pretoria propose that gas released from underground may be killing off the plants in the circular patches. They just don't suggest this gas comes from the mouth of an underground dragon.

The scientists worked out this theory when they collected soil samples from inside the fairy circles and planted seeds inside them. The seeds didn't last for long, and neither did seeds planted directly in the centres themselves. The bare soil, the scientists concluded, provides the real clues. Chemical analysis revealed that natural gas seeping to the surface could be killing the plants. Once the gas finds an outlet it spreads radially outward in a spherical shape destroying grasses in a near perfect circle.

However, yet another recent theory proposes that grasses competing for water and nutrients - limited resources in the Namib desert - create the circles, explaining why they never overlap. When Cramer examined precipitation levels and seasonal temperatures, he found that the occurrence of fairy circles appears to be restricted to particularly arid zones right at the transition from grassland to desert regions.



Inside a fairy circle, nothing seems to grow (credit: Stephan Getzin)

Go west into more arid regions and the circles disappear, go east into the wetter mountains and they vanish. "So it is a very narrow band in Namibia where the conditions are just right," Cramer says.

In these regions, where both rainfall and nutrient levels are low, grasses have to compete for resources. Hardier grasses suck up all the water and nutrients leaving the neighbouring vegetation to die. The gap between vegetation gets larger until eventually water and nutrients pool and collect in the centre like an oasis. Then, larger grasses grow around the pool, sucking out the water and creating a fairy circle.

Tschinkel believes that this theory accounts for all the characteristics of fairy circles, but since his first visit he has been busy testing out theories. He's added zinc to the fairy circles and replaced the soil with other fertile soil only to find the same results as the Pretoria chemists: nothing grows in the circles.

"It is like panning for gold," Tschinkel says. "Once in a while you find a little flake or a nugget and sometimes it is fool's gold."

### **Mystery solved. Or not?**

If there were an award for the time spent examining fairy circles, the prize would surely go to Norbert Jürgens, an ecologist at the University of Hamburg in Germany. By 2013, Jürgens had completed 40 field trips and sampled about 1200 fairy circles, testing the soil and noting the vegetation and organisms present.

Jürgens found only one organism lay within the circle boundaries, in nearly all the circles. And it was the type of animal originally suspected by Tschinkel; a termite, specifically the sand termite *Psammotermes allocerus*.

"So the answer to the criminal question: Who did it?" Jürgens says. "There was only one suspect at each crime site. That was the sand termite."

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*We've had analysis of the soil in labs and we've had people digging in the soil but neither has solved the mystery so far*

The soil-living termites feed on the roots of plants killing them, and then, because no vegetation sucks up the rainwater, water pools below the sandy soil, Jürgens says. This soil water supply allowed the

termites to survive during the dry season and also helped the grasses on the periphery of the circle to thrive.

Jürgens published his findings and theory in the prestigious journal *Science* in 2013 and the ensuing media fanfare dubbed the mystery as “solved.”

But other scientists aren't so sure.



The circles are concentrated within a 1,800km-long strip of land (credit: Stephan Getzin)

“It is the classic mistake of confusing correlation with causation,” Tschinkel says. “There was a high correlation of sand termites in fairy circles but that is not evidence that they are causal.”

The termite theory cannot explain many of the traits of fairy circles, Tschinkel says, including that the circles have a perimeter of tall grass and reside only on sandy soils in a certain range of rainfall.

Other researchers question the theory on different grounds, many unable to find termites consistently in the circles. “The termites are just not there,” Cramer says.



*The circles compete with one another and space themselves apart from the circles around them.*

Among the skeptics is Stephan Getzin, an ecologist from the Helmholtz Centre for Environmental Research, in Leipzig, Germany. As an undergraduate in the 1990s, Getzin had investigated the termite theory but he'd convinced himself that, not only were termites not the cause, but that scientists needed to take a different approach to the problem.

"We've had analysis of the soil in labs and we've had people digging in the soil but neither has solved the mystery so far," Getzin says. "Field studies seem unable to solve the problem at this moment."

And the approach that Getzin took cast a whole new perspective on the puzzle.

### **Fairies dancing in formation**

Scientists had looked underground for gas and dug in the soil for termites and microbes but Getzin wanted a bird's eye view of the challenge. For that he looked at multiple Near InfraRed orthophotos - aerial images that provide an exact geometrical perspective, similar to a map.

In these images Getzin closely inspected not the circles themselves, but the way they lay across the landscape. And he stumbled across a hitherto unknown feature of fairy circles: they dance in formation.





Are scientists any closer to solving the enigma?

Instead of being simply scattered like a collection of dropped coins, the circles lie regularly spaced from one another. Moreover, this patterning remains the same across the landscape.

“It’s a very consistent regular pattern,” Getzin says, “and it is very homogenous at large spatial scales.”

This regular spacing isn’t so unusual in nature. In other regions of Africa, tiger bush - alternating bands of shrubs and bare earth - run parallel to the contour lines of hillsides, in a marked striped pattern. In Australia, burette-like clumps of spinifex grass dot the desert - like fatter, less elegant cousins of fairy circles.



### *They almost function like an organism*

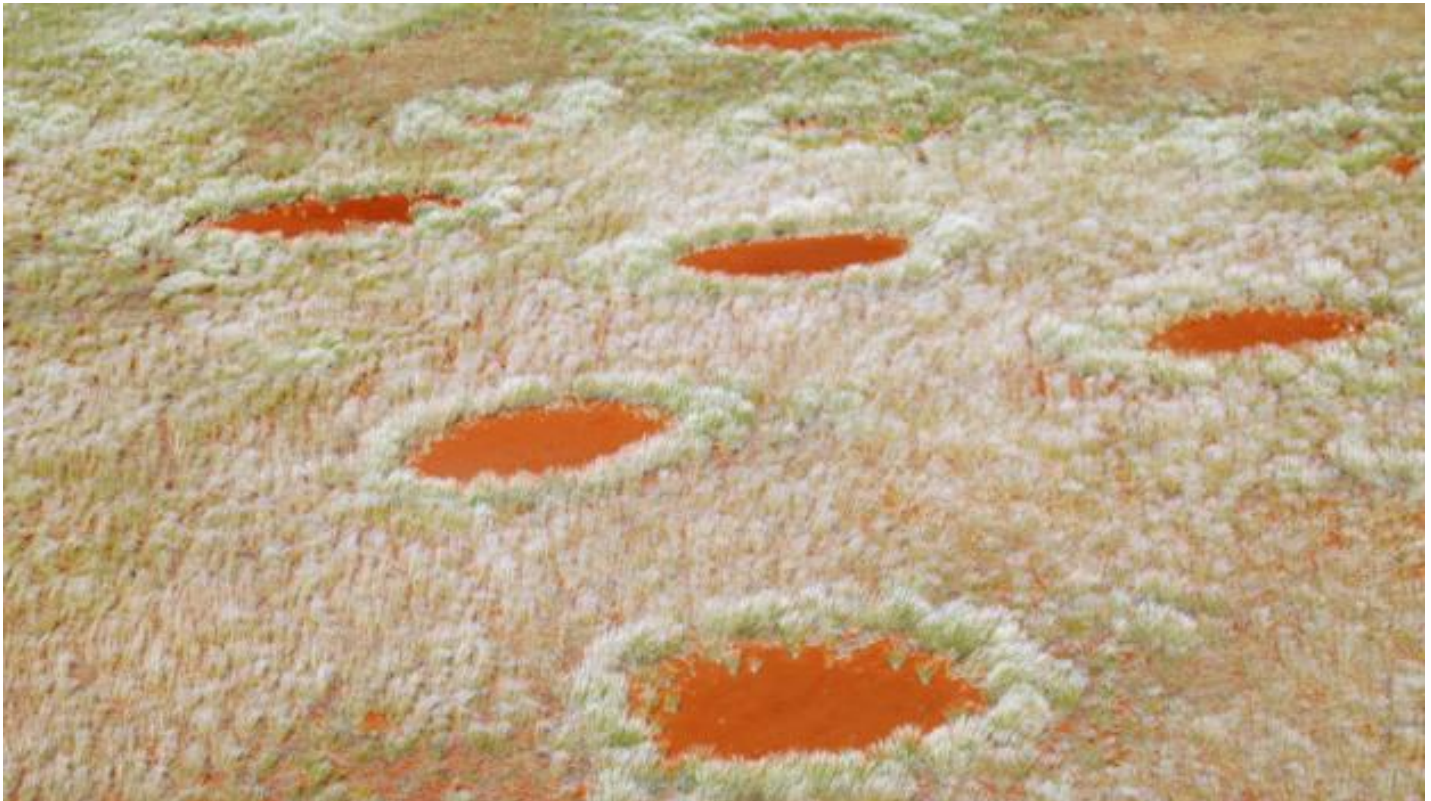
Both these phenomena are caused by arid conditions. When water and nutrients are scarce, plants compete and “organise” themselves sufficiently far from other plants in an arrangement that best conserves resources.

Drawing from these examples, Getzin proposes a similar mechanism lies behind the shape and regularity of the fairy circles. It’s an answer that agrees with Cramer’s competing grass theory.

“The circles compete with one another and space themselves apart from the circles around them,” Cramer says. “They almost function like an organism.”

Creating these patterns over such large scales requires very consistent conditions - like those in the Namib desert, Cramer says. “The park I work in is a sand plain of about 25km across and I think you’d be hard pressed to find any variation across that at all,” Cramer says. “Nutritionally, hydrologically, topologically it is very uniform. “

The finding also calls into question other theories. “Based on all the knowledge that is currently existing those patterns cannot be caused by social insects or gas leakage,” Getzin says.



Observing the circles from the air may provide answers (credit: Stephan Getzin)

So is this finally the end of the mystery?

Getzin is cautious. “What we have done is reopened the whole discussion because we can say with confidence that the termite hypothesis is very unlikely,” he says.

Getzin plans to get funding to have an unmanned aerial vehicle (UAV) fly over the circles in the NamibRand reserve every month. Swooping low, the UAV could record the landscape in greater detail than previously possible.

Such a perspective could reveal other, previously unknown secrets of the circles.

“I’m sure this is not the end of the story,” Getzin says.

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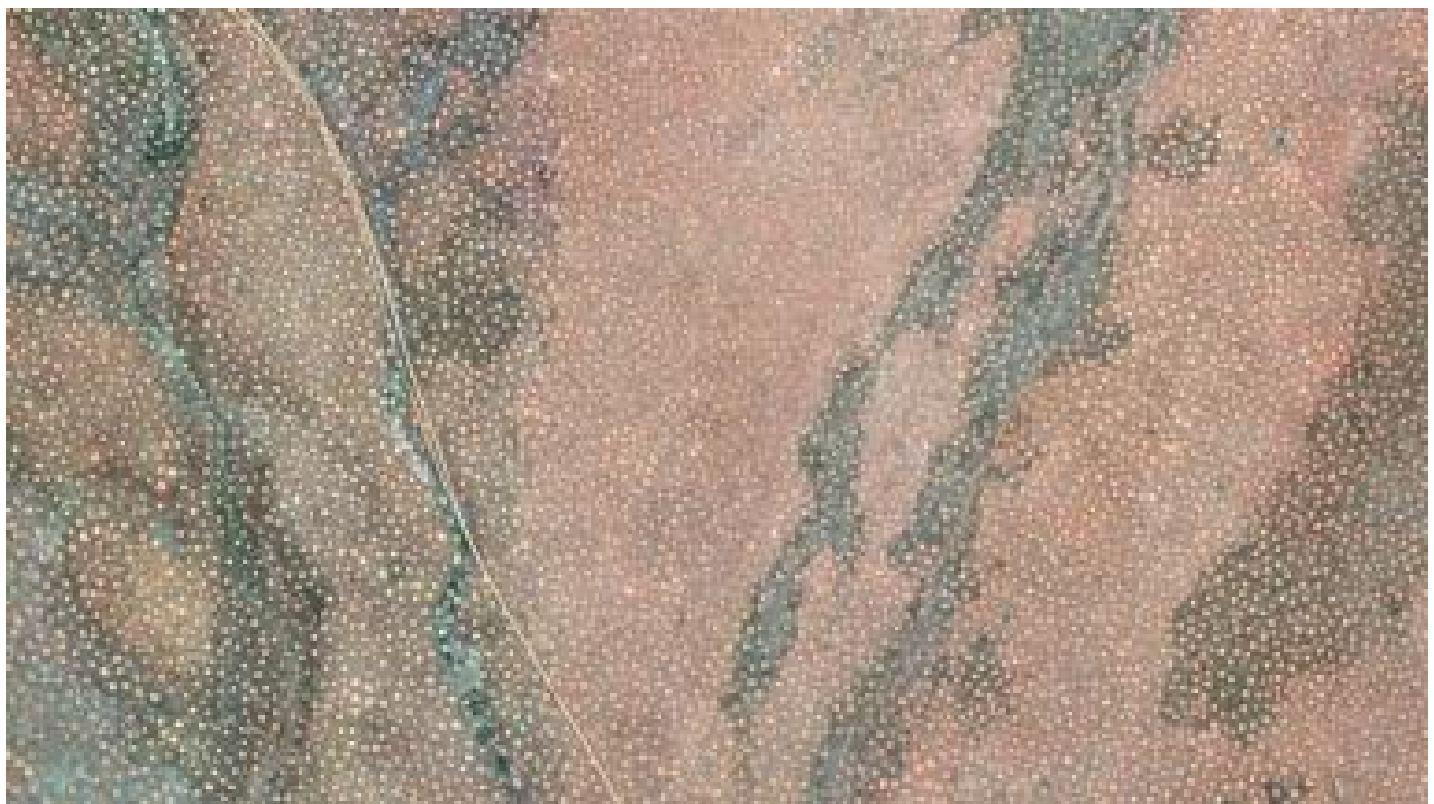


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