Britain's Crop Circles: Reaping by Whirlwind?

Scientists are finally offering down-to-earth explanations for a phenomenon that had been the province of mystics

London—As the English summer turns to autumn and the combine harvesters move out into the fields, it's the end of another research season for Terence Meaden. A former lecturer in physics at Oxford and Grenoble, Meaden has spent the past decade in a frustrating quest for a scientific explanation for Britain's mysterious crop circles. For Meaden, the season has added another 150 or so detailed records of the unexplained patterns in the fields: Some are near-perfect circles, some sets of concentric rings, others are yet more complex. A few are plainly the work of hoaxers, or even of unscrupulous farmers anxious to make a few pounds by charging gullible tourists to look at them. But Meaden is certain that many are the work of a simple but as yet unexplained natural phenomenon.

"The circle problem is definitely a problem in physics and meteorology, needing help from mathematics," says Meaden. While few other scientists are willing to stake their reputations and swear that Meaden is right, this past year a small but growing band of researchers has been willing to ignore all the media hype that links crop circles to the appearance of flying saucers and take a serious look at Meaden's observations. As a result, the first tentative models providing wholly unmysterious explanations of circle formation are now appearing in print.

Even laboratory experiments are under way—a model of the English hills sits in a wind tunnel in Ohio and artificial ball lightning is being used in a Japanese laboratory to create simulated crop circles. Add another astonishing find—circles imprinted in the dust of subway tunnels beneath Tokyo—and you have an emerging field full of unexpected links between disciplines. Indeed, the field is already beginning to split into two camps: those who think an "atmospheric vortex" could produce the circles, and others who postulate that such a vortex must be electrified for it to make such precise patterns.

Aside from risking the ridicule of their peers, the daunting problem facing crop-circle researchers is that no one has ever captured the process of circle formation on film. Meaden tried hard this summer with Operation Blue Hill, in which a team of 40 observers (including 19 Japanese) mounted an around-the-clock surveillance of a likely spot for circle formation, armed with video, infrared cameras, radar, and a bank of automated weather instruments. One circle did appear nearby, but to the researchers' annoyance, mist obscured the view. But there was an up side: The circle formed in a field ringed with automatic alarms and so is unlikely to have been the work of hoaxers.

Unable to snag a circle in the act, researchers have had to settle for a basic data set of more than 1800 records of the size and shape of crop circles and the locations and weather in which they form. Most of the circles have been seen in England, but arguing against the view that they are all hoaxes, circles have cropped up in the United States and Canada, and—totally unnoticed by the Western press—amid the rice fields of Japan.

Meaden has personally seen around 1000 crop circles during the past decade. They come in a range of sizes, he says, from 61 meters to three-quarters of a meter, with most between 3 and 10 meters across. Often the plants inside the circle are flattened into a distinctive swirling spiral that ends abruptly in a sharp wall of standing crop. Most often the circles appear on low-lying land close to an isolated hill or steep escarpment on nights when the weather is calm. Add to these data a set of tantalizing eyewitness accounts, none definitive but all recording a whirling atmospheric disturbance creating the circles in seconds, and you have the basic "symptomology" of crop circles.

The first scientists that Meaden got interested in crop circles were from the U.S. mid-West—tornado country. "My personal opinion," says John Snow, professor of atmospheric sciences at Purdue University, "is that some of the crop circles are possibly due to action by vortices—distant cousins to the dust devil or whirlwind. Air flow in the atmosphere produces vortices very easily on a variety of scales, particularly when the terrain has hills and obstacles in it. Some of the most dramatic ones you can see just walking around buildings on a windy day."

Snow also recognized that an ordinary vortex would not do the trick. Whirlwinds and their relatives run along the ground or fly up into the air. Crop circles, on the other hand, look as if they have been produced by an impact with a spinning mass of air that has glided down—and then vanished.

Thus began a hunt for a new class of descending atmospheric vortex. Snow and Tokio Kikuchi, professor of physics at Kochi University in Japan, both came up with a possible answer: a conventional vortex that has broken down, creating a turbulent descending ring. These "breakdown vortices" are now more than a theoretician's fancy as researchers have detected similar turbulence patterns in dust devils and waterspouts.

REX Photos

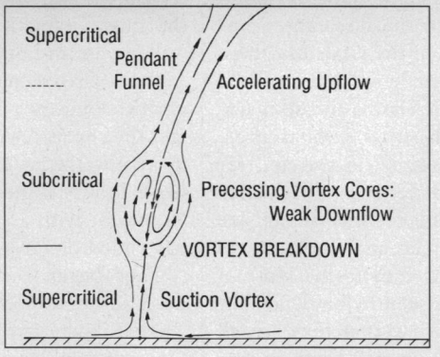
Circleologist. *Terence Meaden with one of the 1000 crop circles he has personally seen over the past decade.*

But if such descending vortices are the cause of crop circles, why should they cluster so heavily in one area of the English hills? The English weather and the lay of the land is Meaden's answer. The low isolated hills, sitting in still air, throw long, unstable eddies far downwind when a gentle sea breeze arrives, according to Meaden. A small number of these eddies may then turn into spinning vortices.

But if Meaden has many answers, he does not have them all. Christopher Church, a professor of aeronautics at Miami University in Ohio, has been testing the

theory with a scale model of the Hampshire hills set in a special wind tunnel at his university. His "tentative conclusion" is that horizontal air flow alone is not enough to generate eddy vortices—some kind of vertical flow (such as a thermal) is needed to start the process. But crop circles appear most often in calm evening air.

Terry Smith/People Weekly



Cause and effect? *1986 tornado in Minnesota appeared to turn inside out, creating ring in which the central flow of air reversed* (right). *Giant UK crop circle under investigation* (above).

A yet untested possibility is that stronger winds higher in the atmosphere help power the vortex—that would fit Meaden's observation that crop circles often appear when it is calm below but windier above.

Even if the birth of an atmospheric vortex can be explained, some critics remain unconvinced that they could cut such precise patterns on the ground. "If we assume that crop circles are genuine," says Roger Jennison, a professor of physics at the University of Kent who has looked at the problem, "I would not go along with any suggestion that they are created by air currents because there would be too much turbulence—you couldn't hope to get anything like such a beautifully defined circle."

Snow disagrees. "A crop is actually a porous surface," he says. "It looks like a solid surface but actually there is mostly open space in there, so a lot of the air flow is inside the plant canopy. That makes a very interesting fluid mechanics problem that I don't think has been addressed well."

But what about the more complex patterns? The really bizarre ones are obvious hoaxes, says Meaden, stressing that he saw nothing but circles during his 7 years work before the media blitz began. Not all those circles are simple, however. Some have an outer ring and others have smaller "satellite" rings nearby. To try to explain these, Meaden suggests that the air in the atmospheric vortices may be ionized (creating what he calls a "plasma vortex") and that interactions between charges can both hold the vortex together and generate more complex patterns.

The idea may sound far-fetched but it rests on a well-established fact: Whirlwinds usually create electric fields from the friction of dust spinning in the air. Even so, Snow, for one, is not buying. "I don't dispute the point that there may be some electrical phenomenon present," he says, "but I view it at best as a secondary effect rather than a primary cause of crop circles." In Japan, however, a team of physicists led by Yoshihiko Ohtsuki, professor of physics at Waseda University in Tokyo, thinks that electrical effects may be the key to the whole phenomenon.

Ohtsuki came to crop circles from a completely different direction. His real interest is in ball lightning—a phenomenon considerably stranger than crop circles but almost respectable, given that only a few scientists still deny its existence.

Most often ball lightning appears during thunderstorms as a hovering luminous "fireball" about the size of a grapefruit. The fireballs can last for several minutes and perform some very bizarre tricks—including moving against the wind and entering houses through a glass window pane (or even through the roof) without causing damage. Ohtsuki's interest in the phenomenon is easy to explain—he saw ball lightning when he was 12 years old, sitting in the bathtub in his country home in Japan.

Since then, Ohtsuki has succeeded in creating ball lightning (or something similar to it) in the laboratory. His "plasma fireball," produced by exciting air with microwaves, can pass through even a 3mm-thick ceramic board without causing damage and can move against a flow of gas—experiments that caused quite a stir when they were published in *Nature* on 14 March this year.

But more important for crop circle researchers is that Ohtsuki has found patterns that look very similar to crop circles—although much smaller in size—in the dust of old subway tunnels in Tokyo, close to the electrical rails. Just coincidence? Ohtsuki does not think so. Rather, he believes that a combination of air eddies and electric charge could be responsible for both kinds of circle.

In the past few months Ohtsuki has been trying to produce these miniature crop circles in the laboratory by dropping plasma fireballs onto a horizontal plate covered with aluminum powder. "It creates very beautiful circles," he says, "including the double rings sometimes seen in fields." More interesting, "in rare cases" he finds the same swirling pattern characteristic of crop circles traced in the aluminum powder.

There is a big problem with Ohtsuki's explanation, however. A lot of microwave energy is needed to create a plasma fireball in the laboratory. Although spinning air can certainly produce plasma (in the sense of ionized air), tornadoes are the only atmospheric vortices seen to produce fireballs. There a violent mass of air amplifies the enormous electrical gradients created by thunderstorms. This is not the sort of weather in which crop circles appear in the English hills, however. "I am sorry," says Ohtsuki, "at this moment we have no idea how the energy is produced."

The obvious next step is to go out in the hills and monitor what happens to the air flows in real life. That would, at a minimum, require a sensitive Doppler radar, a lot of patience, and a medium-sized research grant. But crop-circle research is not yet respectable enough for that kind of funding.

So none of the scientists who have looked at crop circles think that complete explanations will appear any time soon. "One of the things I feel bad about is that the science will probably be lost for a long time because "credible" scientists just don't want to get involved in all the hype," says Snow. "Everyone should be open minded," says Church, "but I wouldn't want to get a reputation among fellow scientists as working on weird and off-beat things."

Meaden too still cares about his reputation—even after a decade obstinately studying the off-beat. "I hope we'll get some firm answers soon," he says. "I don't want to be one of those scientists who is taken seriously 100 years after dying." ■ **ALUN ANDERSON**