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A Reader of Culture in English

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科技新潮

Waves of Science

石油大学出版社

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目　　录

New Discoveries

·新发现·

Life on This Globe

·地球上的生命·

Space and Man

·人与空间·

New Discoveries

新 发 现

Out of the Wreckage

【导读:许多读者可能看过美国电影《龙卷风》,下面的报道说的正是这么一些龙卷风研究人员的工作经历。】

Even by the standards of America's "Tornado Alley", the 76 **twisters** that ripped throught Oklahoma, Nebraska, Kansas and Texas on Monday last week were extreme. The **tornadoes** were the most destructive for decades, killing 47 people, destroying 2000 homes and causing about $500 million worth of damage.

At the same time, the tornadoes have provided an invaluable set of **meteorological** data that could at last allow researchers to begin to understand why some storms **spawn** **devastating** twisters while others produce nothing more damaging that showers of **hailstones.**

"For 30 years, people have tried to look for differences between storms that make tornadoes and ones that don't, and have come up empty-handed," says Paul Markowski, a tornado researcher at the University of Oklahoma in Norman. Twister **chasers** hope that the date they gathered last week will be the key to realising their goal of being able to issue specific warnings when twisters are on their way. "In the next ten years I think we'll have the answer," says Howard Bluestein, also at the University of Oklahoma.

Thunderstorms can form when a warm, damp mass of air at ground level runs underneath a cool, dry mass of air moving in the opposite direction. This situation is highly unstable: when the warm air starts rising through the cool dry air, its moisture condenses to form hail or rain. The **latent** heat released makes the warm air rise higher still.

Such unstable conditions can lead to the formation of **supercells**—powerful thunderstorms with an extremely strong, rotating updraft. They commonly form across the plains states each spring, when the jet stream appears overhead and draws warm moist air over from the Gulf of Mexico.

Last week's storms were unusually numerous and violent—although not **unprecedented.** According to Harold Brooks, a researcher based in Norman with the National Oceanic and Atmospheric Administration (NOAA), a storm that occurred in Oklahoma and neighbouring states in 1991 produced a similar number of equally **vicious** twisters. But because most of them formed in rural areas, there were only two injuries and no **fatalities.** By contrast, the latest tornadoes hit densely populated areas, including Oklahoma City and the nearby town of Morre.

Each spring, weather forecasters watch out for the characteristic **anti-clockwise** spiralling clouds of supercells in Tornado Alley on the US National Weather Service's radar images. But only 20 per cent of super-cells go on to produce tornadoes. So last week, it was impossible to issue definite warnings of **impending** destruction until tornadoes were actually spotted on the ground.

What the forecasters need is a way to predict which suppercells will yield tornadoes and where and when the twisters will appear. Theorists believe that **thermal gradients** in and around the storms are important. The latent heat of condensation warms clouds from within, while the air directly beneath is cooled by **evaporation** of falling rain. The air outside the storm, however, is warmer near the ground and cooler higher up. This difference in temperature gradients may cause air to **barrel over** the ground like a **steamroller.** If this rolling air is then **tilted** onto its side and dragged upwards by the supercell's powerful updraft, it could provide the extra spin needed to spawn a tornado.

Another possibility is that the key factor is the presence of **downdrafts** that pin tornado **funnels** to the ground. But until researchers can see these processes in action, they can't be sure which are the most important. "We're not exactly clueless, but we need more clues," says Bluestein, who has been chasing tornadoes across the plains for more than 20 years.

Such clues are hard to find. In 1994 and 1995, more that 75 researchers led by Erik Rasmussen of NOAA's National Severe Storms Laboratory in Norman and Jerry Straka of the University of Oklahoma took part in VORTEX, the **verification** of the origins of rotation in tornadoes experiment. Using aircraft, mobile radars and trucks packed with meteorological instruments, they studied storms in Texas, Oklahoma, Kansas and New Mexico. Although they are still **sifting** through the data, it's already clear that at the resolution at which they studied the storms—taking measurements every 5 to 10 kilometres—there are no obvious differences between those that produced tornadoes and those that didn't.

So last year, Rasmussen, Straka and a handful of other VORTEX researchers set out to obtain higher-resolution data by getting as close as 2 kilometres to the tornadoes. They followed storm after storm, yet not a single one yielded a twister. "We got great data for supercells, but we badly need some tornado data to compare those with," says Markowski.

Now at last tornado researchers may have that information. When last week's tornadoes struck, Joshua Wurman of the University of Oklahoma and his colleagues took two trucks fitted with **Doppler radars** and **intercepted** the twister that hit Oklahoma City, measuring the highest wind speed ever recorded— 512 kilometres an hour. They also obtained nearly 30 miuntes of continuous data on a tornado measuring more than 1.5 kilometres across, with peak wind speeds of some 320 kilometres an hour.

Meanwhile, Bluestein and his colleagues were using a new higher-frequency radar system that can **probe** winds on an even finer scale— 15 metres or less. Their truck was just a kilometre or so from the Oklahoma City tornado, and

Bluestein believes they have obtained spectacular data on the region where the tornado funnel touched the ground. Straka's team followed three tornadoes, measuring pressures, temperatures and moisture levels.

When they are pieced together, these data should help to pin down the factors that make relatively **benign** supercells spawn meterorolgical phenomena that still inspire awe even among those who have witnessed their power on hundreds of occasions. "When you go out there and watch a tornado, it's this tremendous release of energy that you have no control over," says Bluestein. "You're completely helpless."

FEW PEOPLE who see the heart of a tornado live to tell the tale. But on 22 June 1928, Kansas farmer Will Keller paused at the hatch of his **cyclone** cellar to watch a tornado lift off the ground and pass right over his head. This is his account:

"There was a circular opening in the center of the funnel…The walls of this opening were of rotating clouds and the hole was made brilliantly visible by constant flashes of lightning which zigzagged from side to side… Around the lower **rim** of the great **vortex** small tornadoes were constantly forming and breaking away. These looked like tails as they **writhed** their way around the end of the funnel. The direction of rotation of the great whirl was anticlockwise, but the small twisters rotated both ways."

Notes:

1. **twister** [ˈtwistə]: 旋风。
2. **tornado** [tɔːˈneidəu]: 旋风;龙卷风。
3. **meteorological** [miːtiərəˈlɔdʒik(ə)l]: 气象的;气象学的。
4. **spawn** [spɔːn]: 酿成;大量生产。
5. **devastating** [ˈdevəsteitiŋ]: 毁灭性的。
6. **hailsone** [ˈheilstəun]: 冰雹块。
7. **chaser** [ˈtʃeisə]: 猎人。
8. **latent** [ˈleitənt]: 隐藏的;潜伏性的。
9. **supercell**: [super+cell] cell: 【气】云泡。
10. **unprecedented** [ʌnˈpresidentid]: 空前的;史无前例的。
11. **vicious** [ˈviʃəs]: 恶性的;邪恶的。
12. **fatality** [fəˈtæliti]: 死亡的;厄运。
13. **anti-clockwise** [ˌæntiˈklɔkwaiz]: 逆时针;又作 counter-clockwise.
14. impend [imˈpend]: 迫近;威胁。
15. thermal [ˈθəːm(ə)l]: 热量的;热的。
16. **gradient** [ˈgreidiənt]: 斜率;倾斜度。
17. **evaporation** [ivæpəˈreiʃ(ə)n]: 蒸发。
18. **barrel over**: 滚过。
19. **steamroller** [ˈstiːmrəulə]: 蒸汽压路机。
20. **tilt** [tilt]: 倾斜;倾向。
21. **downdraft=downdraught** [ˈdaundrɑːft]: 下沉气流。
22. **funnel** [ˈfʌn(ə)l]: 漏斗;漏斗状的东西。
23. **verification** [ˌverifiˈkeiʃən]: 证实;查证。
24. **sift** [sift]: 筛;过滤。
25. **Doppler radar**: 多普勒雷达。
26. **intercept** [intəˈsept]: 截取。
27. **probe** [prəub]: 探索;用探针探测。
28. **benign** [biˈnain]: 善良的。

29. **cyclone** [ˈsaikləun]：龙卷风，暴风。
30. **rim** [rim]：边；轮缘。
31. **vortex** [ˈvɔːteks]：旋涡；旋风。
32. **writhe** [raið]：扭动，扭动身体。

Magnetic Shift

【**导读**:地质学家们最近分析了保留在 35 亿年前的岩石中的地球磁场痕迹,发现它们与现今的两极状态下的磁力分布形式很不同。这一发现有可能改写地球的地质历史。】

Traces of the Earth's **magnetic** field frozen in rocks are **yielding** surprises about the planet's past. A re-analysis of old measurements of these fields has forced geologists to conclude that either the migrating continents were **clustered** closer to the **equator** than previously thought, or that the Earth's magnetic field was not the simple pair of poles it is today.

Geologists track the history of continental motion by measuring the magnetism of ancient rocks. As some rocks form, they retain an **imprint** of the Earth's magnetic field. The field direction and the age of the rock together show the **latitude** of the continent at the time the rock formed, provided that the shape of the **terrestrial** magnetic field at the time can be worked out.

Today, the Earth's magnetic field lines, which **emanate** from the poles and surround the planet, have a simple and predictable distribution. Geologists have proved that for at least five million years the field has been a **dipole**, like a bar magnet with poles aligned on the planet's axis. And they calculate ancient latitudes assuming the field has always been a dipole, says Dennis Kent of the Lamont-Doherty Earth Observatory in Palisades, New York.

But now Kent and Mark Smethurst of the geological Survey of Norway in Trondheim have analysed **palaeomagnetic** data from rocks up to 3.5 billion years old. Instead of the magnetic distribution expected from a dipole, they found and excess of rocks from older eras with low-angle fields, as if they had formed at lower latitudes than those predicted by standard models that assume a random distribution of the early continents (Earth and planetary Science Letters, vol. 160, p. 391). "The surprising result is that in the **Palaeozoic** and **Precambrian**, the distributions differ markedly," Kent says.

One possible explanation is that the Earth's magnetic field has not always been a dipole. Kent calculates that if the ancient Earth contained elements of between four and eight poles, its magnetic field lines would have met the migrating continents at lower angles that the lines of the modern dipole field. That would account for the distribution he and Smethurst observed, he says. Such an arrangement might have been possible before the solid part of the core — which started growing as late as a billion years ago — reached its present size.

The other possible explanation for the findings, Kent says, is that the continents were once clustered near the equator. Such clustering could be the result of centrifugal