

**STREAMING SAND:** Physicists from the Materials Research Science and Engineering Center at the University of Chicago used high-speed photography to measure minute levels of surface tension and detect droplet formation in flows of dry granular materials. HELGE F. GRUETJEN, JOHN R. ROYER, SCOTT R. WAITUKAITIS, AND HEINRICH M. JAEGER, THE UNIVERSITY OF CHICAGO

## Stream of sand behaves like water

Research opens up new experimental territory

National Science Foundation

University of Chicago researchers recently showed that dry granular materials such as sands, seeds, and grains have properties similar to liquid, forming water-like droplets when poured from a given source. The finding could be important to a wide range of industries that use "fluidized" dry particles for oil refining, plastics manufacturing, and pharmaceutical production.

Researchers previously thought dry particles lacked sufficient surface tension to form droplets like ordinary liquids. But, in a first-time accomplishment, physicists from the Materials Research Science and Engineering Center at the University of Chicago, led by Professor Heinrich M. Jaeger, used high-speed photography to measure minute levels of surface tension and detect droplet formation in flows of dry granular materials.

The science journal *Nature* reports the finding in its June 25 issue. The materials research center at the University of Chicago is supported by the National Science Foundation.

Until recently, studies of so-called free-falling granular streams tracked shape changes in flows of dry materials but were unable to observe the full evolution of the forming droplets or the clustering mechanisms involved.

"Previous studies of granular streams were able to detect clustering by performing experiments in vacuum and were able to establish that the clustering was not caused by the drag from the ambient air," said Jaeger. "However, the cause of the clustering remained a mystery."

But in this new experiment, researchers measured nanoscale forces that cause droplet formation using a special co-moving apparatus devised for a high-speed, \$80,000 camera that captures images much like a skydiver might photograph a fellow jumper in free fall.

They observed falling 100-micrometer-diameter glass beads, or streaming sand, and found that forces as much as 100,000 times smaller than those that produce surface tension in ordinary liquids could cause droplet formation in granular streams and cause these dry streams to behave like an ultra-low-surface-tension liquid.

John Royer, graduate student in physics at the University of Chicago, who developed the apparatus, and his colleagues also directly measured grain-to-grain interactions with an atomic force microscope.

"At first we thought grain-to-grain interactions would be far too weak to influence the granular stream," said Royer. "The atomic force microscopy surprised us by demonstrating that small changes in these interactions could have a large impact on the break-up of the stream, conclusively showing that these interactions were actually controlling the droplet formation."

Researchers say understanding how dry materials coalesce could create greater efficiencies in their transportation and manipulation. The pharmaceutical production of pills, for example, could benefit by pouring equal amounts of a drug into a capsule every time while greatly reducing waste.

"Estimates show that we waste 60 percent of the capacity of many of our industrial plants due to problems related to the transport of these materials," said Jaeger. "Hence even a small improvement in our understanding of how granular media behave should have a profound impact for industry."

The researchers write in their report that these "experimental results open up new territory for which there currently is no theoretical framework."

"Our experiments ask two questions for which currently there is no established answer," said Jaeger. "Both questions are about how a liquid breaks apart. How does the break-up proceed in the ultra-low surface-tension limit and what happens in the ultra-low temperature limit when particles cease to move relative to each other?"

"It is quite remarkable that a granular stream consisting of macroscopic particles provides a model system to explore it."

## Playing the flute: 35,000 years ago

LONDON (Reuters)—People have been making music for more than 35,000 years, judging by prehistoric bird-bone flutes excavated in southwest Germany.

Researchers say they have found a five-hole flute made from the radius bone of a griffon vulture and two fragments of ivory flutes in a cave in the Swabian Jura mountains.

The flutes are at least 5,000

years older than any previous confirmed archaeological examples of musical instruments.

"These finds demonstrate the presence of a well-established musical tradition at the time when modern humans colonized Europe, more than 35,000 calendar years ago," Nicholas Conard of Tuebingen University and colleagues reported in the journal *Nature*.

# Tuning in to numbers stations

By LEONARDO VINTIÑI  
Epoch Times Staff

Atención! ...9-8-9-0-2... Atención! 9-8-9-0-2... Atención 9-8-9-0-2... 1-8-5-0-2... 1-8-5-0-2...

Upon hearing a robotic female voice dictating these monotonous numerical sequences, many would simply discount it as gibberish and immediately change the frequency.

However, if these puzzled listeners choose to listen to these transmissions, they might assume it was some sort of secret code. Regularly repeated, seemingly nonsensical statements such as "mixture-nine-six-two-nine-two-three-bingo-tour, two-eight," must have some meaning to someone. But to whom, and why would they require that their instructions be transmitted in such a cryptic way?

Numbers stations are found throughout the short wave radio frequency. Anyone with basic equipment can listen to it, although it may be hard to tell who's sending the message, much less what they're trying to say.

### A BRIEF HISTORY OF NUMBERS STATIONS

Such transmissions have been sent since World War I. Hence, it can be affirmed that they are one of the first radio broadcasts known. These broadcasts can be found in all parts of the world, and they have significantly increased since World War II, but it has been noted that they occurred most frequently during key events throughout the Cold War. When the Cold War ended, these broadcasts began to diminish, although since the 1990s these transmissions have been gradually returning.

While many radio aficionados have attempted to decode these messages, few have met with any success. Nevertheless, many of these cryptic broadcasts began to find some popularity among radio enthusiasts. The great majority are found cataloged by the "European Numbers Information Gathering and Monitoring Association" which had charted the distinct numerical emissions by strict typology.

Some number issuers have gone to international press, but perhaps the most well known was the "Atención!" case—shown above—named for the particular way each message began (Spanish for "Attention"). The "Atención!" broadcast was actually used in U.S. federal courts in the trial



**BY THE NUMBERS:** Found in shortwave radio frequencies, a number of broadcasts transmit mysterious strings of numbers. But who are these messages for? PHOTOS.COM

of five captured Cuban spies in 2001.

### TYPICAL OPERATIONS

Through the static we begin to hear exotic music. It is soon joined by the occasional hammering of what sounds like a stenographer at work. Suddenly, the music stops and a male voice begins to dictate a series of numbers in a foreign language.

These numerical broadcasts basically observe the same form: At regular intervals—either on the hour or half hour—a voice recites a word or phrase, which may also be accompanied by a melody that acts like the introduction to the code. As the transmission continues, the voice begins to dictate numbers, letters, disconnected words, or a combination thereof. Later, a closing message signals the end of the transmission.

Of course there are many varieties of such broadcasts. Every hour, day after day, it can be the same or it can change; the message can be replaced by Morse code, and the message can be repeated once, twice, and so on.

These transmissions, emanating from across the globe in a variety of languages, are only broadcast for a few minutes at a time. Sometimes an actual human voice recites the code, but often they are

generated by speech-synthesizing software. Others come from one particular language, but the code for the transmission is in another. For example, a Spanish message transmitted its code in Japanese.

One of the most curious transmissions is accompanied by the melody "Don't Cry For Me Argentina." After the familiar tune is introduced a voice recites "whiskey, tango, romeo 21... whiskey, tango, romeo 21, 61115 74939 04343 54388 40121 43372 43973 08610 08858 699 00 74821 11431 06109 39994 whiskey, tango, romeo 21."

Other transmissions have included drumming or a single clarinet playing a repeated refrain from a military march. As with other examples, the code follows the introductory music.

Many of these mysterious broadcasters have adopted methods of not only mixing music with code but also using unusual voices. Some believe that this is a strategy used to distract the hundreds of radio aficionados who are trying to decode the transmission. For example, children's voices are often used with a familiar melody to make the inexperienced receiver believe that the transmission is merely a playful experiment using a household broadcasting device. So what's behind these myste-

rious broadcasts? Is it a method used for drug smuggling, or is it, as many believe, a covert language that spies employ to communicate with each other. Although there is evidence that suggests espionage, no government has ever declared taking part in such communications, nor have they confessed knowledge of their origin.

Except in isolated cases in which they have been allowed to glimpse at the use of such broadcasts, the world's intelligence agencies have never admitted the probable use of these transmissions. However, considering that Great Britain is said to have outlawed listening to these numbers stations, many believe such suspicions have already been confirmed.

### LISTENING TO NUMBERS TRANSMISSIONS

The following are a few examples of these broadcasts:

[http://www.furelos.org/file/tcp\\_d4\\_23\\_unidentified\\_chinese\\_station\\_irdial.mp3](http://www.furelos.org/file/tcp_d4_23_unidentified_chinese_station_irdial.mp3)

[http://www.furelos.org/files/tcp\\_d4\\_01\\_russian\\_man\\_complete\\_irdial.mp3](http://www.furelos.org/files/tcp_d4_01_russian_man_complete_irdial.mp3)

[http://www.furelos.org/files/tcp\\_d4\\_26\\_wiskey\\_tango\\_viente\\_y\\_uno\\_irdial.mp3](http://www.furelos.org/files/tcp_d4_26_wiskey_tango_viente_y_uno_irdial.mp3)

# Saturn's moon may hide watery caverns

Shows potential for life to exist

LONDON (Reuters)—Saturn's icy moon Enceladus could contain watery underground caverns, forming a potential home for alien life, scientists say.

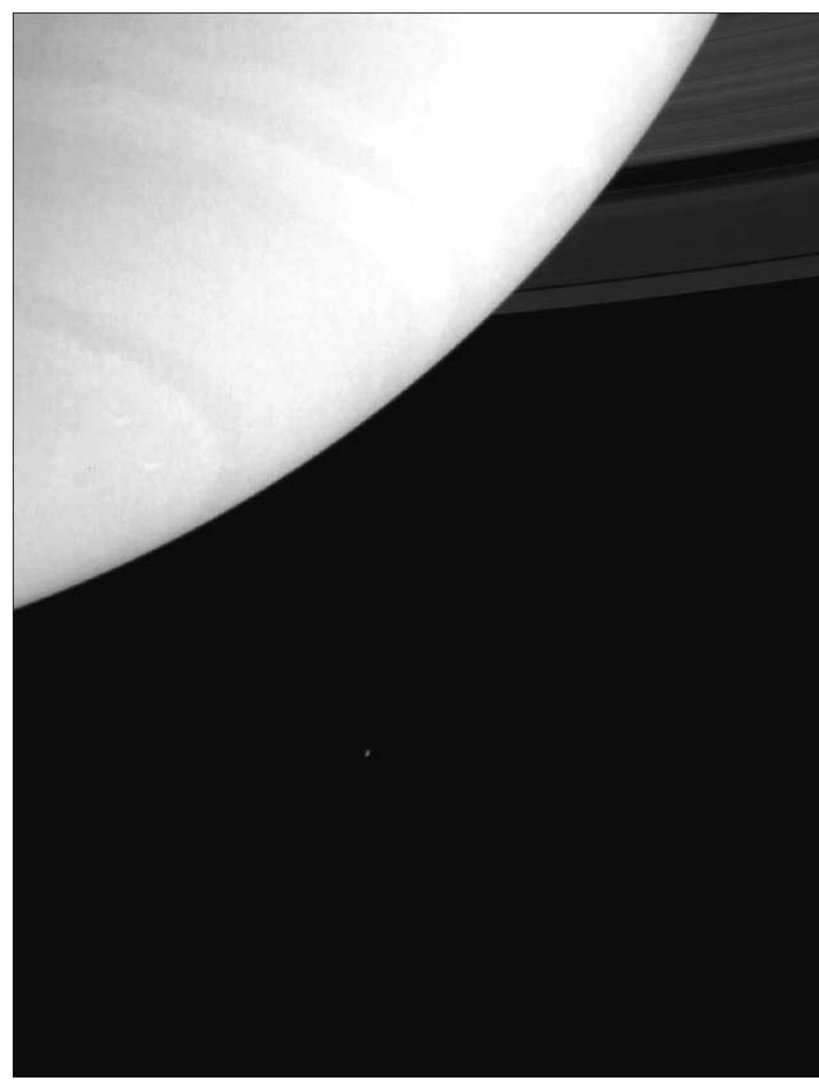
German researchers have found salt—a signature chemical for seawater—in ice grains from vapor jets streaming out of surface cracks, providing the strongest evidence yet of a liquid water reservoir beneath the moon's frozen crust.

A U.S. team said the amount of salt they had detected using a different method suggested an earlier theory that water was boiling explosively into the vacuum of space via geysers was wrong, and evaporation was occurring quite slowly.

Both studies were published in the journal *Nature*.

One explanation for the slower evaporation may be that water is emerging from pressurized chambers below the so-called tiger stripe fractures in the moon's surface, said John Spencer of the Southwest Research Institute in Boulder, Colorado.

"Our picture of its sub-surface must now be expanded to include the possibility of misty ice caverns floored with pools and channels of salty water, lurking beneath the tiger stripes," he wrote in a commentary on the two scientific papers.



**LIFE POTENTIAL:** Scientists believe that one of about Saturn's 60 moons, Enceladus (lower right), may demonstrate the possibility for life. HO/AFP/GETTY IMAGES

"What else may lurk in those salty pools, if they exist, remains to be seen."

The Cassini spacecraft first discovered huge plumes erupting from fissures near the south

pole of Enceladus in 2005, sparking speculation of a vast underground ocean spewing vapor through giant Yellowstone-like geysers.

Since then, scientists have debated whether this meant that Enceladus (pronounced en-SELL-ah-dus), with a diameter of only 310 miles, was hiding a reservoir of liquid water. It is one of about 60 moons of the ringed planet Saturn.

Frank Postberg of the Max Planck Institute for Nuclear Physics in Heidelberg said the presence of sodium salts was compelling evidence, indicating salty minerals were washed out from rock on Enceladus in the same way oceans absorb salt on Earth.

He and colleagues reported they had found salty grains of ice after analyzing data from Cassini's cosmic dust detector as it flew through Saturn's outermost ring, where Enceladus orbits.

Whether or not Enceladus harbors life remains a mystery. But the evidence of liquid water, coupled with heat near the moon's south pole, suggests it is possible.

"If you have this large amount of water in contact with a rocky core and you have heat, then you have very good conditions," Postberg said in a telephone interview.

"On top of that we measured a slightly alkaline pH value, which is very good for the formation of complex organic molecules."

Scientists hope to find out more when Cassini makes two more close fly-bys of Enceladus in November.