Myriad Monsters Confirmed in Water Droplets

LONDON, November 1677—A Dutch merchant's startling claim that thousands of tiny monsters frolic within a single droplet of water was verified at the Nov. 15 meeting of the Royal Society of London.

Society Fellow Robert Hooke, who made the decisive confirmation, describes the wonders as "perfectly shaped" with "such curious organs of motion as to be able to move nimbly, to turn, stay, accelerate, and retard their progress at pleasure."

Antony van Leeuwenhoek.

A correspondent of the society, draper and haberdasher Antony van Leeuwenhoek of Delft had described miniature creatures in a letter published in the March PHILOSOPHICAL TRANSACTIONS. To see the cavorting creatures, Leeuwenhoek fashioned a device of the type called a microscope. It uses a bit of glass to enlarge the view of an object.

His letter inspired a brisk correspondence as Society Secretary Henry Oldenburg pressed for details "that others may confirm such observations."

The discoverer of the watery menagerie seems to take such doubt in stride. "I can't wonder at it, since 'tis difficult to comprehend such things without getting a sight of 'em," Leeuwenhoek replied. With the next account of his miniature world, he provided testimonials from eight eyewitnesses, including three pastors and a notary public.

At a society meeting earlier in November, fellows squinted into a variety of water droplets but reported only uncertainty about discerning any of the predicted creatures.

At the most recent meeting, their efforts at last succeeded. Hooke displayed droplets of rainwater to which he had added a pinch of common black pepper. Within these droplets danced a variety of little animals, some "so exceedingly small that millions of millions might be contained in one drop of water," he reports.

"Of this, the president and all the members present were satisfied," says Hooke. Witnesses included several barristers and the architect Christopher Wren.

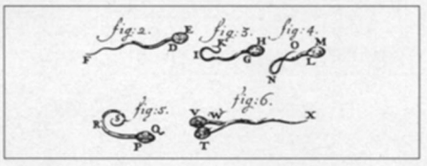
His Majesty, founder and patron of the Royal Society, has not issued a direct comment but, according to Hooke, is desirous of observing the animalcules for himself.

The notion that some kind of life or animation abounds in a miniature realm is not entirely new. None of the earlier claims, however, had the detail—or impact—of the March publication. For example, Leeuwenhoek himself in a letter to the society several years ago had also made brief mention of miniature creatures. Even earlier, during an outbreak of plague in Naples, Father Athanasius Kircher used a microscope to detect animated particles in blood drawn from the victims

In his March publication, Leeuwenhoek reported finding in plain rainwater animals "more than a thousand times less [in size] than the eye of full-grown louse." He described some as composed of "very clear globules" without obvious skin.

"When these animalcules bestirred 'emselves, they sometimes stuck out two little horns, which were continually moved, after the fashion of a horse's ears," he said. "These little animals were the most wretched creatures that I have ever seen," he noted. They blundered into the many tiny particles in water and had to stretch and struggle to work themselves loose.

Leeuwenhoek also examined pepper-water, the material used in the confirmatory experiment, and saw "very little round animalcules" with "so swift a motion



Animalcules. Figure 6 shows two animalcules lying against each other.

before the eye, as they darted among the others, that 'tis not to be believed." He also found "little eels, or worms, lying all huddled up together and wriggling."

SCIENCE NEWS has learned that Leeuwenhoek intends to expand his searches beyond water to scrapings of his own teeth, collections from his chamber pot, and discharges from both gonorrhea patients and healthy men. It seems that the miniature world that he has glimpsed could easily occupy him for half a century.

He says that his earliest sighting of thousands of animalcules in a drop of water "was for me, among all the marvels that I have discovered in nature, the most marvellous of all; and I must say, for my part, that no more pleasant sight has ever yet come before my eyes." —*S. Milius*

With new vaccine, scientist prevents rabies in boys

PARIS, October 1885 —Scientist Louis Pasteur has stunned the French Academy of Medicine with the news that he has prevented two boys from contracting rabies.

Since antiquity, the appearance of rabies symptoms has been a death sentence. The agony, hydrophobia, and madness it causes make rabies greatly feared here, even though only a few hundred people die of it in France each year.

Louis Pasteur.

A 15-year-old shepherd, Jean-Baptiste Jupille of Villers-Farlay, nearly joined them this month. The boy was bitten several times while he fought and drowned a rabid dog that had attacked him and his fellow shepherds.

Luckily, the mayor of Villers-Farlay had heard that Pasteur this summer had saved a 9-year-old boy, Joseph Meister, who was bitten repeatedly by a rabid dog. Starting 3 days after the dog attack, Pasteur and his colleagues injected young Meister 13 times over 10 days with rabid rabbits' nerve tissue that had been dried in a bottle with potash. The drying had weakened the tissue's virulence but left the material strong enough to awaken the boy's defenses against rabies, says Pasteur.

By the time Jupille arrived in Paris, 6 days had elapsed since he was bitten. But injections with increasingly powerful vaccine over 2 weeks have worked, proving the Meister case was no fluke, the researchers report.

Pasteur is hesitant to proclaim the treatment a sure bet, but some of his colleagues aren't so cautious. "I have no doubt that this treatment will always be successful if it is properly administered within a few days after a rabid bite," physician Alfred Vulpian told the academy.

The inoculation derives from laboratory tests on animals that Pasteur began in 1880. He and his colleagues found that transferring brain matter from a rabid rabbit to a healthy one would infect the latter rather than immunize it. Pasteur and Emile Roux eventually devised a way to weaken, or attenuate, the invisible germ.

Rabies research is precarious. In experiments to infect and inoculate laboratory ani-

mals such as dogs, Pasteur and his team keep a loaded revolver within reach as they work on the sleeping beasts. It isn't just for the animals but also for the researchers. "If a terrible accident were to happen to one of them, the more courageous of the others would have to put a bullet in [the injured person's] head," says Roux's niece Marie Cressac. If the reported treatment becomes routine, life in the laboratory could become much less tense.

Pasteur's latest accomplishment comes at a time in life when most people reduce their workload. Even though he is 62 and partially paralyzed by a stroke, Pasteur continues to experiment as he has all his life.

In his youth, Pasteur discovered properties of crystals, but he later studied bacteria. He found that these tiny microbes can cause disease and spoilage. Pasteur's knowledge of bacteria led to a heating process that kills microbes that spoil wine, beer, and milk. This process is being called pasteurization, in honor of the versatile scientist. He also debunked the theory of spontaneous generation—the ancient belief that living things could grow from naught.

In other research, Pasteur found the microbe that was killing silkworm eggs and so saved the French silk industry from disaster. He cured chicken and swine diseases, devising a vaccine against anthrax. Until he did, French sheep farmers were losing up to 30 million francs a year to this disease.

Pasteur turned to rabies in part to prove the principle of vaccination, which still has doubters even though English physician Edward Jenner 89 years ago showed that cowpox inoculates people against smallpox.

Pasteur's aversion to rabies may also stem from an incident he witnessed as a child in the village of Arbois. When Pasteur was 9, a rabid wolf bit several people there. Neighbors rushed one man to a blacksmith's shop, where his wound was cauterized with a branding iron—killing the rabies before it could infect his body. Other bite victims were not so lucky.

Despite his successes, Pasteur is not uniformly popular among the science elite. He can be harsh with his colleagues. For example, he once said of them, "One must not assume that an understanding of science is present in those who borrow its language."

A close associate, Charles Nicolle, says Pasteur is "possessed of that indomitable temerity that a sacred delirium imparts to the genius." —*N. Seppa*

Gravity tugs at the center of a priority battle

CAMBRIDGE, England, July 1686 — A bitter dispute over who came up with a fundamental rule of gravity threatens the publication of a sweeping new theory on the nature of planetary motion.

The theory at issue is the work of Isaac Newton of Trinity College in Cambridge, already known and highly respected for his research in optics and mathematics. Newton proposes a law of gravity based on the idea that bodies attract each other in proportion to their masses and inversely as the square of the distance separating them. Doubling the distance between two celestial bodies, for instance, would reduce the gravitational force between them to one-quarter of its previous value.

Isaac Newton, Lucasian professorship of mathematics, Trinity College, Cambridge.

Newton's forthcoming book, *Philosophiae Naturalis Principia Mathematica*, explains how his theory accounts for the elliptical orbits of planets, the motion of comets, the occurrence of tides, and a variety of other phenomena.

It's an "incomparable treatise," says Edmond Halley, clerk to the Royal Society for the Improvement of Natural Knowledge in London, who is in charge of publishing Newton's book and has studied the first two parts of the manuscript.

Now, Robert Hooke, secretary to the Royal Society, contends that Newton did not himself invent the notion that an inverse-square force law governs planetary motion. "Newton stole the idea from me," he insists.

Hooke says that he had written to Newton about planetary and projectile motion in 1679, after developing his own "system of the world" to explain natural phenomena. He admits, however, that he was unable to master the mathematics required to show how elliptical orbits arise from an inverse-square law.

Acknowledging that Newton had succeeded in solving the mathematical problem but incensed that his own name is not mentioned in a section of Newton's treatise recently read at a Royal Society meeting, Hooke has demanded that Newton give him proper credit in the *Principia* for the inverse-square law.

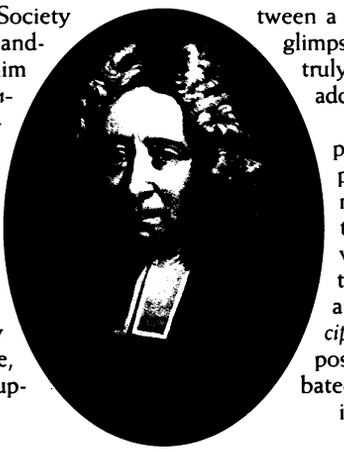
According to Halley, however, Newton insists that he himself had discovered the inverse-square law during his studies of planetary motion. Unlike Hooke, Newton had not come upon it by accident, Halley says.

In the latest development, Newton appears to have gone through the existing manuscript to delete Hooke's name from any pages in which it had been mentioned. He has also informed Halley by letter that he intends to suppress the third part of the *Principia*.

"Philosophy [science] is such an impertinently litigious lady that a man had as good be engaged in law suits as have to do with her," Newton wrote. Clashes with Hooke over scientific matters on two previous occasions appear to rankle him still.

Newton's threat to withhold a critical portion of his highly anticipated book comes as a great shock to Halley. A few weeks ago, the Royal Society's council had approved Halley's plan to publish all three books of the *Principia*. Because of its own financial difficulties, stemming from the commercial failure of an elaborate book on the history of fishes, the society had made Halley personally responsible for funding Newton's publication.

Hooke's claims are "outrageous," says Christopher Wren, former professor of astronomy at the University of Oxford. "The consensus at the society—and in the coffeehouses—is that Hooke is making a fool of himself."



Edmond Halley, clerk, Royal Society for the Improvement of Natural Knowledge, London.

There is a great distance between a truth that is merely glimpsed and a truth that is truly demonstrated, he adds.

If Newton's book is published, it may prove hard going for most readers. Newton has boasted privately to a friend that he has deliberately made the *Principia* as unreadable as possible "to avoid being bated by little smatterers in mathematics."

"It's a tough book to dip into," says a critic who has seen portions of the manuscript. "Only experts will be comfortable with it."

"Not even the author could possibly understand it," adds a Cambridge student.

Halley sees it differently. "It's an epoch-making book," he says. "Newton unifies the disparate theories of Galileo and Kepler into a single, coherent, mathematically and experimentally supported whole."

Halley is cautiously optimistic that once the storm blows itself out, Newton will continue preparing the *Principia* for publication.

If it's completed and printed, Halley says, "the world will pride itself to have a subject capable of penetrating so far into the abstrusest secrets of nature and exalting human reason to so sublime a pitch by this utmost effort of the mind." —*I. Peterson*