Mysterious Blue Light of Minute Bubbles Now Finding Practical Uses

By MALCOLM W. BROWNE

For 62 years physicists have marveled at the mysterious light emitted by microscopic bubbles when liquids are bombarded by blasts of high-pitched sound. The cause of this eerie blue light remains uncertain, but experiments are now beginning to find practical applications.

Speculation in recent years that solonuminescence might one day be used to force solvent atoms to fuse and yield immense amounts of energy has so far come to nothing, aside from its use as a plot device in a recent science-fiction movie, "The Electric".

But some less spectacular applications of the phenomenon have been discovered. A new form of ultrasonic transducer has been invented which can generate sound waves that will cause bubbles to emit light, and solonuminescence, once a mere laboratory curiosity, is maturing as a serious and useful branch of science.

At a meeting of the Acoustical Society of America in Hawaii this month, scientists presented rival theories in an effort to explain solonuminescence. The organizers of the symposium, Dr. Robert E. Aplin of Yale University, collected 11 different hypotheses submitted by physicists specializing in solonuminescence, along with their proposals for experiments to test them. Fresh experimental results will highlight two major advances in solonuminescence since 1977.

Certain features of solonuminescence are clear. One is the tremendous concentration of energy in the supersonic waves. Another is the ability of the sound waves to cause the bubbles to collapse, producing a flash of light, and solonuminescence, once a mere laboratory curiosity, is maturing as a serious and useful branch of science.

But even without jets, solonuminescent bubbles are often irregularly shaped and not perfectly spherical, as once thought. Using an ultrasonic transducer, Dr. Aplin's group at Yale photographed solonuminescent bubbles as they expanded and collapsed. They found that these bubbles assumed very irregular shapes. With a different apparatus using a fast pulsed laser, Dr. Putnam's team found that the solonuminescence emitted from a single bubble was not a single common direction, but varied in intensity as the bubble contracted.

Several research teams have hypothesized that a single solonuminescent bubble may produce a flash only if it microscopically breaks up into smaller bubbles. But the detection of X-rays from a solonuminescent bubble would offer a new step toward fusion. In this series of experiments, the bubble could be raised to a level at which it would be ignited — provided someone finds a way to make hydrogen bubbles, and that the experiments can be repeated. And if the experiments can be repeated, then the energy Release could be increased.

Among the scientific tools applied to investigating the secrets of solonuminescence are powerful computer models developed for the design of hydrogen bombs. A group from Lawrence Livermore Laboratory led by Dr. William C. Moss applied some of these models to analyze the behavior of a solonuminescent bubble and to make some predictions that can be tested in future experiments. These computer models are based on partial differential equations that can be solved numerically. And while these equations are still under development, they offer a promising new approach to understanding the behavior of solonuminescent bubbles.

As for the mystery of how solonuminescence is caused, it is still a mystery. But in recent years, researchers have found that the light is emitted from a small nucleus that is left behind when the bubble collapses. This nucleus can emit a flash of light, and the light is then used to heat the product.

In one, an intense sound "field" created by the equivalent of loudspeakers surrounding a test chamber causes solonuminescent bubbles to form spontaneously and collapse. The bubbling liquid in the chamber emits a steady solonuminescent glow.

In the "single bubble" version of solonuminescence, one small bubble is boiled into existence by a hot wire immersed in water, and the bubble is then acoustically resonated (or "vibrated") at the center of the chamber, where sound waves influence it and form it according to the principles of solonuminescence. As long as the sound continues to resonate, the bubble expands and collapses and produces pulses of light in close to the frequency of the sound, up to 100,000 times a second.