EXPERIMENTAL SOLUTION FOR SCHRODINGER'S CAT PARADOX: EVIDENCE THAT AN ORGANISM CAN BE DEAD AND ALIVE AT THE SAME TIME

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Abstract. The present studies were initially based on dwarf forms released from disrupted cells of Stentor coeruleus. Dehydration of the Stentor media in deep well slides (n=9) caused disruption of these large cells. Rehydration with sterile media allowed formation of mobile dwarf forms. The latter (n=9) placed in a toxic solution lost mobility and showed evidence of cell death, i.e., apoptosis. Deep well slides (n=9) containing sterile Stentor media were used as controls. Following dehydration/rehydration in the Stentor media, 7 of 9 showed mobile dwarf cells compared to 0 of 9 with the sterile media alone, $p<0.05$). Within 8-15 minutes, the stationary dwarf cell progressively released a morphological replicate of the dead cell which contained entrapped bacteria. Subsequently, the replicate faded allowing the bacteria to disperse. As a conclusion, dwarf cells of Stentor coerulrus placed in a toxic solution showed characteristic evidence of cell death, apoptosis. Within minutes a morphological replicate of the cell separated from the dead cell and subsequently faded. These findings are analogous to several principles of Quantum theory on a macroscopic level including entanglement, superposition and wave/particle duality. This provided evidence for the organism being simultaneously alive and dead as proposed in Schrödinger's cat paradox.
Keywords: *Stentor, dwarf cell, Quantum theory, replicate, entanglement*

Introduction

The foundations of quantum mechanics were established during the first half of the 20th century by Max Planck, Niels Bohr, Werner Heisenberg, Louis de Broglie, Albert Einstein, Erwin Schrödinger, and many others. One of the major principles of quantum theory was that subatomic units called quanta behave as either particles or waves and it was uncertain at any time which existed. Schrödinger's cat paradox was a theoretical thought experiment to describe this duality in a living organism. If the cat was placed in a closed box with a device that would release a toxic gas at a time unknown to the observer, and the box was opened randomly, would the cat be alive or dead. Schrödinger, on the basis of quantum duality proposed that the cat could be dead and alive at the same time.

What has now become a "pop culture staple" (Kramer, 2019), actually represents an attempt to bring the formal principles of quantum mechanics from the sub atomic level into the macroscopic domain. In a recent theoretical review (Trevors and Masson, 2011) the authors stated, "…biologists and physicists are starting to demonstrate linkages between various quantum principles like quantum tunneling, entanglement and coherence in biological processes". They suggest the term, "Quantum Microbiology" for the application of quantum theory to living organisms.

Our previous reports in unicellular plant (Scherlag and Elkholey, 2018) and animal (Scherlag et al., 2018) organisms showed the operation of quantum tunneling that

allows migration of organisms across physical barriers. In the present study we observed the events occurring during the transition of the death of a unicellular organism as it relates to Schrödinger's paradox.

Materials and Methods

Stentor cultures were obtained from the Carolina Biological Supply Company, Burlington NC, USA. Dwarf organisms were obtained as described in a previous report (Scherlag, 2017). Briefly, deep well slides (n=9) were filled with Stentor containing culture media and allowed to evaporate for 24 hours. Rehydration was achieved by refilling each slide with sterile commercially obtained Stentor media, also sourced from Carolina Biological. A plastic spacer, 2.5 mm width, was placed over each uncovered slides and a glass plate over all the slide prevented evaporation of the unsealed contents. The next day, each of the deep well slides was examined microscopically and found to contain many mobile dwarf cells as well as progenitor cells each of which gave rise to 4 dwarfs (Scherlag, 2017).

A pipette was used to transfer the liquid contents from each of 5 slides into a small beaker. An aliquot of tap water was added to the beaker and the contents thoroughly mixed (CCR Report Preview, 2017). Each of 5 deep well slides was filled with the mixture and enclosed with a snap cover, active group. The liquid contents from the other 5 slides without the tap water served as the control group. The slides from each group were viewed by a Nikon TMR, inverted microscope and the other placed on the stage of an OMAX video microscope. Micro-photographs and videos were recorded by a camera attachment to the Nikon microscope and from the OMAX microscope, respectively.

Result

Over a period of 8-15 minutes the cells of the active group lost mobility and their inclusions also ceased any movement. The stationary cells then underwent sequential changes (*Figure 1A to 1D*) consisting of the progressive development of a replicate image being released from the original cell. Within 20-30 minutes the replicate gradually fades. (*Figure 1E and 1F*).None of the control group showed these changes.

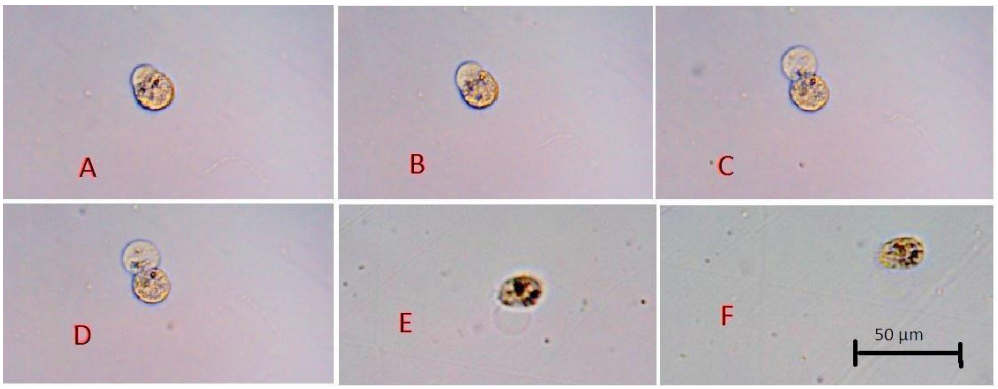

Figure 1. *Time lapse illustrations of the progressive release of a replicate image from the moribund cell (A-D). Subsequently the replicate disappears (E, F).*

It was noted that the replicate image manifested two separate appearances. Either it was essentially transparent or several moving particles were released from the cell which was entrapped within the replicate. However, when the replicate began to fade these particles escaped into the local environment.

Discussion

Major findings

The results of our present findings provide an extension of our previous studies showing that when the dwarf Stentor cells were subjected to a toxic solution, the dying/dead cell released a replicate body which in a relatively short time faded from view.

In an initial report we documented that dwarf cells (25-40 microns) of the unicellular organism, Stentor coeruleus, could be cultured from the large Stentor cells (750-1000 microns) after evaporation in uncovered deep well slides. The Stentor dwarfs developed from the numerous micronuclei release from the disrupted membranes of the large cells. After rehydration of the slides with commercially obtained cell free Stentor media (Scherlag, 2017), the release of micronuclei from these cells were shown to form progenitor cells in the rehydration solution. Progenitor cells when viewed for several minutes microscopically underwent a unique reproductive process, giving rise to 4 actively, mobile dwarf cells (Scherlag, 2017). In subsequent studies we found that these dwarf cell when subjected to a toxic solution, i.e., chlorinated tap water, would undergo apoptosis (programmed cell death) including the development of transient blebbing (Scherlag et al., 2018). Of greater interest, the dying/dead cell released a replicate within 8-15 minutes which initially progressively formed and then faded from view after 20-45 minutes (*Figure 1*).

We have previously suggested that the fading phenomenon shown by the replicate image may be due to the movement from the visible to the non-visible portion of the electromagnetic spectrum. Another line of evidence characterizing the magnetic properties of the replicate image was the observation that the developing replicate entrapped bacteria that appeared to escape from the apoptotic cell. We hypothesize that the replicate possessed magnetic properties which faded allowing the bacteria to escape (Scherlag et al., 2019).

Thus, the dual nature of these organisms, physical and electromagnetic is analogous to the basic duality inherent in Quantum theory. Indeed, a recent theoretic presentation stated that, "Quantum biology is emerging as a new field at the intersection between fundamental physics and biology" (Bordonaro and Ogryzko, 2013).

Limitation

Questions remain as to the actual death of the dwarf subjected to a toxic solution such as chlorinated water. In their studies Sun and Montell (Sun and Montell, 2017) suggested that dead cells, having undergone apoptosis, had reached the point of near death since the enzyme, which they identified as ―executioner caspase‖ had not been activated. We have not, as yet, determined the role of this enzyme in our apoptotic cells.

Conclusion

Mobile dwarf cells derived from the organism Stentor coeruleus were subjected to a toxic environment initiating cell death. Within minutes each stationary cell progressively released a morphological replicate with entrapped bacteria. Subsequent fading of the replicate allowed dispersion of the bacteria. These findings are analogous to several principles of Quantum theory on a macroscopic level including entanglement, superposition and wave/particle duality and provide evidence for the organism being simultaneously alive and dead as proposed in Schrödinger's cat paradox.

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