List of Movies

The following movies were taken during my period of laboratory research between July 2009 and December 2012 and uploaded to YouTube. I performed all the experiments and took the footage in these films except where I note otherwise. Many more videos of my laboratory experiments are archived and documented at TheGrayanat channel on YouTube.

Movie 6.1: YouTube. (6 December 2011). Bütschli droplets in dish. [video] Available at: http://www.youtube.com/watch?v=66_mumayfOU. [Accessed 19 April 2014]. Production of Bütschli droplets which form when droplets of 5 M sodium hydroxide containing 1% v/v food colouring (red and blue) are added to a 3.5 cm glass dish of olive oil. The chemical field of activity begins to distort and spread out through the process of saponification, breaking into millimetre scale droplets. Experiment and movie by Martin Hanczyc —— **84**

Movie 6.2: YouTube. (8 January 2011). Protocell circus. [video] Available at: http://www.youtube.com/watch?v=66_mumayfOU. [Accessed 19 April 2014]. Bütschli droplets show a range of distinct characteristics that lend themselves to classification through distinct morphological and behavioural types that emerge from the self-organizing field. This movie is subtitled with 'thought moments' conceived by Michael Simon Toon, who also edited my laboratory footage – using a black and white camera conducted in a laboratory context, and photographically recorded using a Nikon Eclipse TE2000-S inverted microscope with a Photometrics Cascade II 512 camera and in-house software – into a series of moments that raise questions about the nature of 'life'. Magnification 4× —— **87**

Movie 6.3: YouTube. (16 October 2011). Active front of protocell system. [video] Available at: http://www.youtube.com/watch?v=g2FyK7P-UBA. [Accessed 19 April 2014]. Active fields are evocative of moving islands of 'fire and ice' where it is possible to determine which direction the field is travelling in from its characteristic morphology. These formations are generated at the earliest stages of dynamic droplet generation and arise from the chaotic field of self-organization that exist when alkali meets oil. Their mixing results in the emergence of a continually evolving polarized front, which exhibits striking characteristics. The leading edge of the polarized field is reminiscent of 'fire' and its trailing edge, laced by forming soap crystals, is suggestive of 'ice'. Magnification 4× —— **88**

Movie 6.4: YouTube. (16 October 2011). Shell formation in protocells. [video] Available at: http://www.youtube.com/watch?v=Jq_-lAkXGBI. [Accessed 19 April 2014]. Turbulent, shell-like structures are observed at the early, high-energy stages of formation of the Bütschli system that are indicative of dissipative structure formation, which is characteristic of living systems (Prigogine, 1997). Magnification 4× —— **89**

Movie 6.5: YouTube. (16 October 2011). Solitary protocell. [video] Available at: http://www.youtube.com/watch?v=-Pq28c2IdnY. [Accessed 19 April 2014]. Polarized, free-moving droplet beginning to produce a 'skin' of soap crystals at its posterior pole. Magnification 40× —— **92**

Movie 6.6: YouTube. (16 October 2011). Evolution of protocell movement. [video] Available at: http://www.youtube.com/watch?v=9tmTDvL1AUs. [Accessed 19 April 2014]. Free-moving droplet producing an 'osmotic' structure at the posterior pole. Magnification 4× —— **93**

Movie 6.7: YouTube. (10 December 2010). Protocell cast. [video] Available at: http://www.youtube.com/watch?v=YjJA_Wi7G6o. [Accessed 29 April 2014]. Droplet producing substantial osmotic cast from which it breaks free. The residue is seen under light microscopy and with fluorescent stains to demonstrate that the residue is an aqueous structure bounded by soap crystals. Magnification 40× —— **94**

Movie 6.8: YouTube. (16 October 2011). Protocell building microstructure. [video] Available at: http://www.youtube.com/watch?v=FGHFX5Bzehc. [Accessed 19 April 2014]. Droplet produces a long thin organic-looking osmotic microtube at its posterior pole. Magnification 4× —— **94**

Brought to you by | Graduate School, CAS
Authenticated
Download Date | 10/15/16 7:18 PM

Movie 6.9: YouTube. (27 November 2011). Protocell fusion. [video] Available at: http://www.youtube.com/watch?v=etxx90zQ_sQ. [Accessed 19 April 2014]. Two Bütschli droplets fuse at random to produce a new growth point for a conjugated osmotic structure. Magnification 4× —— **96**

Movie 6.10: YouTube. (16 October 2011). Protocell interfacing. [video] Available at: http://www.youtube.com/watch?v=qYGFdfklQzo. [Accessed 19 April 2014]. Interfacing droplets share a 'kissing-like' action. Magnification 4× —— **97**

Movie 6.11: YouTube. (16 October 2011). Protocell mirroring. [video] Available at: http://www.youtube.com/watch?v=6JjQSPmLdnI. [Accessed 19 April 2014]. Droplets morphologically 'mirroring' each other. Magnification 4× —— **98**

Movie 6.12: YouTube. (16 October 2011). Satellite phenomenon. [video] Available at: http://www.youtube.com/watch?v=hCsAocVheVc. [Accessed 19 April 2014]. Droplets exhibiting the satellite phenomenon where smaller agents frequently orbit larger ones. Magnification 4× —— **98**

Movie 6.13: YouTube. (18 October 2011). Protocell dynamic chain. [video] Available at: http://www.youtube.com/watch?v=IiUgrYcKScc. [Accessed 19 April 2014]. Chain formation in dynamic droplet assemblage. Magnification 4× —— **99**

Movie 6.14: YouTube. (16 October 2011). Protocell roses. [video] Available at: http://www.youtube.com/watch?v=zESChUdLtrc. [Accessed 19 April 2014]. An assemblage of droplets in a rose-like formation. Magnification 4× —— **99**

Movie 6.15: YouTube. (16 October 2011). Four protocell agents interacting. [video] Available at: http://www.youtube.com/watch?v=vmh8AXXYXjI. [Accessed 19 April 2014]. Rosette-like assemblage of dynamic droplets in a landscape of osmotic structures.Magnification 4× —— **99**

Movie 6.16: YouTube. (16 October 2011). Protocell phase transition colony. [video] Available at: http://www.youtube.com/watch?v=gB6MKMqbLIM. [Accessed 19 April 2014]. Spontaneous phase change in morphology and behaviour in an assemblage of dynamic droplets. Magnification 4× —— **101**

Movie 6.17: YouTube. (12 October 2012). Bütschli system phase transition. [video] Available at: http://www.youtube.com/watch?v=k4jxTNnVs_c. [Accessed 29 April 2014]. Spontaneous phase change in morphology and behaviour in an assemblage of dynamic droplets. Magnification 4× —— **103**

Movie 6.18: YouTube. (30 November 2011). Dynamic droplets reach quiescence. [video] Available at: http://www.youtube.com/watch?v=3RjTnNfV85A. [Accessed 19 April 2014]. Dynamic droplets approach thermodynamic equilibrium. Magnification 40× —— **103**

Movie 6.19: YouTube. (16 October 2011). Protocell 'death'. [video] Available at: http://www.youtube.com/watch?v=YY9mIKSzNeU. [Accessed 19 April 2014]. Polyp-like droplet in trio reaches quiescence. Magnification 4× —— **103**

Movie 6.20: YouTube. (31 August 2012). Bütschli ring of fire. [video] Available at: http://www.youtube.com/watch?v=K4LzhjodlAg. [Accessed 29 April 2014]. Bütschli droplet prevented from making contact with the base of the petri dish using a thin layer of DEPP. This results in disorganized activity, which takes the appearance of a 'solar flare', rather than producing behaviours associated with self-organization such as osmotic structure production. Magnification 4× —— **104**

Movie 6.21: YouTube. (14 December 2011). Effect on acetone on Bütschli droplets. [video] Available at: http://www.youtube.com/watch?v=zrO2iY9s-0g. [Accessed 30 April 2014]. The addition of acetone to the oil medium of the Bütschli system causes chemotaxis and mass flow movements, which are likely to be due to the reduction in surface tension and increased interfacing between the Bütschli agents – but this has not been experimentally proven. Magnification 4× —— **107**

Movie 6.22: YouTube. (8 December 2011). Bütschli system under the influence of alcohol. [video] Available at: http://www.youtube.com/watch?v=Z2IZH1JSugY. [Accessed 30 April 2014]. Ethanol

Brought to you by | Graduate School, CAS
Authenticated
Download Date | 10/15/16 7:18 PM

has an immediate effect on the Bütschli system when added directly to the oil medium, causing the droplets to move quickly towards the source. The droplets become very agitated but this excitement is quickly quenched. Magnification 4× —— **108**

Movie 6.23: YouTube. (14 December 2011). Multiple interfacing Bütschli droplets under the influence of butan-1-ol. [video] Available at: http://www.youtube.com/watch?v=r30w2ScbBHA. [Accessed 30 April 2014]. Bütschli droplets appear to form assemblages more readily in the presence of butan-1-ol. Magnification 4× —— **110**

Movie 8.1: YouTube. (23 December 2011). Growth of Traube cell membrane, light microscopy 10×. [video] Available at: http://www.youtube.com/watch?v=vA_Y87DNkeo. [Accessed 28 May 2014]. Detail of Traube cell membrane undergoing almost instantaneous rupture and repair following the build-up of osmotic pressure inside a copper hexacyanoferrate semi-permeable membrane, which is produced when copper sulphate and potassium hexacyanoferrate react. The growth of the membrane is jerky and produces an undulating, seaweed-like structure. Magnification 40× —— **178**

Brought to you by | Graduate School, CAS
Authenticated
Download Date | 10/15/16 7:18 PM