Supporters of sperm
The 12th Biology of Spermatozoa meeting, Hassop Hall, Derbyshire, UK

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The Biology of Spermatozoa (BoS) meetings have run on a biannual basis since the early 1990s. They are dedicated to the fascinating research topic of sperm and their complicated route to fertilization. The BoS meetings focus on sperm, but they also explore additional supporting factors important in fertilization, such as those present in seminal and ovarian fluid, as well as the genomic bases of sperm biology. Here, I present a report of the recent BoS meeting, and showcase some of the highlights of this year’s meeting.

Tim Birkhead and Harry Moore (University of Sheffield, UK) have run the Biology of Spermatozoa meetings since 1992. The meetings are held in the Peak District outside Sheffield (UK)—this year at Hassop Hall, Derbyshire—where delegates are truly spoiled; both with splendid food and beautiful English countryside, but most importantly we are treated to several days fully dedicated to sperm biology. I have had the privilege of attending these meetings since 2001, easing my introduction into the world of science, reproductive biology, and scientific conferences. It has been the best start a young scientist could wish for, due to the unique atmosphere. The BoS meetings are small, friendly, highly interactive, and with a focus on work in progress and on discussion. The giants of sperm competition research are regular attendees, and international experts treat us to exciting plenaries on a broad range of topics linked to sperm biology. Plenaries are followed with shorter talks from scientists at very different career stages (PhD-students to well-established professors), always with ample time provided for discussions. The interactive atmosphere is further facilitated during meal and coffee breaks, giving everyone a chance to interact. As a result of the careful organization, the meetings are a very useful vehicle for fostering effective communication, collaboration, and connectivity within the research community, inspiring novel and interdisciplinary research.

The meetings typically cover research areas from sperm morphology, male–male and male–female interactions affecting the success of sperm, and fertility issues relating to common and endangered species. Consequently, we are often presented with amazing images and videos of the most varied cell in the animal kingdom, such as the helix-shaped sperm of passerines, hooked heads of wood mice sperm, or the behavior of color-tagged Drosophila sperm within the female. This encompasses medically important research concerning fertility issues in humans, ranging to conservation issues in endangered species, for example, videos of electro-ejaculation of large mammals, such as elephants and rhinos.

This year, Bob Montgomerie (Queens University, Canada) opened the meeting with an inspirational plenary highlighting some of the “knowns and unknowns” in sperm biology and post-copulatory sexual selection. Bob highlighted important outstanding questions, including those relating to haploid expression, energy production by sperm, intra-ejaculate variation, and differences in sperm size across species. On the topic of sperm morphology and variation, Bob introduced us to an amazing scientist who was, at least to me, a new star in the sky of sperm research: Gustav Magnus Retzius (1842–1919). Retzius was an exceptionally productive researcher in many areas in and outside biology and was nominated for the Nobel Prize an amazing 23 times! (Although, sadly, he never won.) It wasn’t until he was in his 60s that he became interested in sperm morphology, eventually describing and illustrating the sperm of no fewer than 400 animal species! He described sperm in minute detail and realized that morphologically simpler sperm seem to occur in species more basal in phylogeny. Although Retzius used the best tools available during his time, his achievements are impressive even today. Why bother with history one may ask? The answer is, as Bob demonstrated, that much can still be learned from Retzius’ detailed work, which continues to be a source of inspiration and both data and ideas for today’s researchers.

Bringing us back to our own century and to the supporters of sperm, Mariana Wofliner (Cornell University, USA) showed us that there are other important players in sexual selection other than gametes. Mariana’s detailed and extensive work on seminal fluid proteins in Drosophila identifies new seminal fluid players in the pathways affecting female flies, and their interactions with sperm. Mariana focused here on signaling pathways of ovulin (a protein that stimulates egg laying), and the way seminal fluid proteins are activated in a series of steps inside the female.
influenced both by male seminal fluid and something else yet unknown, to cleave ovulin.

On the fundamental and long-standing question of how sperm and egg meet, Matt Gage (University of East Anglia, UK) showed that in salmon and trout, species that are compatible on the gamete level, conspecific ovarian fluid attracts sperm and affect their longevity and motility. Variation in ovarian fluid thus affects fertilization success and sperm–ovarian fluid interactions explain bias in fertilization between these species. Matt also demonstrated that competition over sex can save you from extinction; sexual selection can facilitate rescue from the negative effects of inbreeding, at least if you are a flour beetle!

At BoS we are always treated to a broad range of species, and this year’s meeting included several novel species and mating systems. Åsa Lankinen (Swedish University of Agricultural Science) asked fundamental research questions familiar in animal models, relating to gamete competition, male–female interactions, and sexual conflict, but in a flower known as Purple Chinese Houses (Collinsia heterophylla). Furthermore, in discussions of sexual reproduction and why there are males, Hanna Kokko (The Australian National University) presented information on the mating system of unicorns(!). Apparently, in this system, egg casting occurs, that is, eggs travel and sperm stays with the male. I used to think that theoretical evolutionary biologists were losing out by not doing “real” biology. However, I now realize that theoreticians have access to species and areas of biology that empiricists miss out on. I cannot help wondering what unicorn sperm would actually look like, as we did not get to see any pictures in this case. But we did get to see pictures of bundled scale insect sperm with large axonemes (Ben Normark, University of Massachusetts, USA), and even a video of the movements of human sperm being laser beamed! The latter during the talk of Joachim Wistuba (University of Munster, Germany), demonstrating part of a method developed to estimate sperm nuclear DNA assessment by RAMAN microspectroscopy, for cryopreservation of immature sperm for fertility preservation.

Compared with previous years, this year there were more presentations on the genetics, genomics, and proteomics of sperm and reproductive traits. Yasir Ahmed-Braimah (University of Rochester, USA) presented work on genetic barriers to interspecific associative fertilization in Drosophila. This results in reproductive isolation occurring post-insemination pre-zygote, with the consequence that American males particularly were terrible at fertilizing foreign females. Erica Leiden (Turku University, Finland) was looking for a spermatogenesis gene in passerines, while Steve Ramm (University of Bielefeldt, Germany) showed socially sensitive gene expression in male seminal fluid gene expression of see-through hermaphrodite flatworms. Helen Bayram (University of Liverpool, UK) examined social influences on ejaculate investment in rodents, by the use of quantitative proteomics. While in taxa normally consider to not have non-sperm components in their ejaculate, we learned from Findley Finseth (University of Montana, USA) both how to obtain foam that supports quail sperm in fertilization, and that there may be orthologs in chicken ejaculate (even though chickens do not produce this foam).

On the topic of sperm energetics, David Froman (Oregon State University, USA) presented work on chicken lines selected for high and low sperm mobility, where mobility seems to be independent of mitochondria numbers. On the other hand, across species of rodents, sperm ATP content varied depending on polyandry intensity, suggesting selection for increased sperm motility through increased ATP concentration (Max Tourmente, Museo Nacional de Cencias Naturales, Spain).

Steve Dorus (Syracuse University, USA) discussed what may be the first study of sperm epigenomics, the famous Överkalix studies showing fascinating sex-specific trans-generational effects where grandparent nutritional status affects disease risk in grandchildren. The mechanism for this trans-generational effect is, however, still unknown. Steve’s work demonstrates that paternal RNA is found in Drosophila embryos, David Hosken (University of Exeter, UK) also discussed paternal RNA transfer to eggs, encouraging further work on their function and potential trans-generational influence on offspring. David also rounded up the meeting with several classical, unexplained questions in sperm biology, including why we still observe variation in sperm size despite directional selection, and what the fitness consequences of sperm variation really are.

This year, we also discussed how to deal with the attention our research receives from the public. The public are often interested in research relating to reproduction, but this attention may not always be positive. This seems to be particularly relevant when we conduct basic, blue-skies research where applied aspects are less obvious. Thus, outreach is important and encouraged, but it can be worth clarifying the societal value of our research, to avoid or reduce any negative attention based on misunderstandings of the importance of basic research.

The Winner of the Silver Sperm Award

Before revealing this year’s BoS winner of the Silver Sperm award, I should provide a brief history of the BoS awards. The first award went to Geoff Parker (University of Liverpool, UK), who has been dubbed “the father of sperm competition” and who is also a faithful attendee and inspiring contributor to BoS meetings. He has attended every meeting since 1992. In 2007 Geoff received the Spallazani Medal and a cake beautifully decorated with (sugar) sperm racing toward an egg. The second awardee (in 2011) was Nina Wedell (University of Exeter, UK), who was awarded a silver sperm trophy partly to celebrate her continued attendance at BoS meetings, but more relevantly for her extensive work in the field of sperm competition. Nina’s work has recently involved showing the negative effects that selfish genetic elements have on sperm production and the dramatic evolutionary consequences this can have for both sexes. This year’s Silver Sperm award went to someone who has repeatedly inspired and fascinated us with the wonders of sperm: Scott Pitnick (Syracuse University, USA). Scott was awarded his PhD from University of Arizona in 1992, and is currently a professor of Biology at the University of Syracuse, with over 70 scientific publications. Some of the many highlights of Scott’s contributions to the field
of sperm biology and reproduction include the impressive length of giant sperm, which measure nearly 6 cm (yes centimeters!). This is the longest sperm known in the animal kingdom, and is produced by a male only a couple of millimeters long (Drosophila bifurca). Further, Scott has shown that in bats, larger testis are maintained in polyandrous species at the expense of larger brain sizes, showing us what is most important in life (at least in certain bats). Additionally amazing and mind-blowing, even science-fictionesque, is his work with genetically engineered flies that have sperm heads tagged fluorescently red or green. Labeling sperm of different males different colors enables live observations of their interactions, even within the female! These observations of sperm behavior while swimming through the seminal receptacle of female Drosophila melanogaster, enable direct observations of sperm in the difficult field site of the female tract, and show that sperm behavior differs from what was previously understood (these very cool videos are available on his group’s homepage: http://pitnicklab.syr.edu/Pitnick/Home.html). Scott’s work therefore both challenges our traditional views of sperm being numerous and small, confirms the strong selection pressure from sexual selection, and provides us with new tools enabling live observations of sperm previously not possible. A very well deserved Silver Sperm winner, and we greatly look forward to further developments from his lab!

In summary, this year’s BoS meeting was a true joy throughout! Except, perhaps, for the only emerging tradition that I do not fully support: dismal weather during the Peak District walk. But even despite this, the walk was still highly enjoyable due to the brilliant company and great scenery.

As a final word, while these meetings are dedicated to the fascinating world of sperm, they also remind us that there are other important players in fertilization. Our knowledge of the diverse factors that support sperm is growing, and shows that these can be highly influential for the success of sperm. Nevertheless, the main players of both the BoS meetings and fertilization in general, remain the gametes.

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