Roscoff (France), 13-17 septembre 2015

Construction, réparation et évolution des tissus

Building, repairing and evolving biological tissues

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Rapport sur la Conférence
Conference Report

Introduction

A first series of Jacques Monod Conferences centered on Developmental Biology took place between 1998 and 2003. Alain Vincent re-initiated and modernized this series in 2012 with a Conference on the *"EMERGENCE and EVOLUTION of DEVELOPMENTAL PATTERNS"*. The aim of this conference was to bring together established leaders in the fields of Cell, Developmental and Evolutionary Biology, with a perspective in systems biology and mathematical modeling. This JMC was unique in that it brought together three seemingly distinct groups of people, developmental biologists, evolutionary biologists, and physicists. As a result, new ideas and points of view where explored and cross-discipline dialogues were established. In light of this success, we decided once again to bring together the same three disciplines to discuss the latest advances in developmental biology paying particular attention to the generation of tissue pattern and shape under normal physiology, as well as to tissue repair and regeneration. This gave focus to the conference while allowing us to discuss a broad range of subjects.

The conference was organized along 5 themes:

(1) Specifying and evolving patterns, size and shape
(2) Collective behavior
(3) Self-organisation
(4) Regeneration, repatterning and repair
(5) Tissue homeostasis, amplification, quiescence and apoptosis.

Conference statistics

The program comprised the following presentations:
- 2 plenary lectures by outstanding individuals (1 hr each),
- 26 presentations by invited speakers (25 min + 5 min for questions)
- 9 short presentations selected from the abstract (12 min + 3 min for questions)
- 10 flash talks also selected from the abstract (5 min).

The flash talks were an innovation of this conference. They were designed to allow young scientists to gain experience in public speaking while advertising their poster. The flash talk slots were equally split between PhD students and post-docs.

8 invited speakers were from outside Europe, 10 from Europe outside France, and 10 from France.
3 selected speakers were from Europe outside France, and 6 from France.
1 flash speaker was from outside Europe, 5 were from Europe outside France, and 4 from France.

For invited speakers, the female/male ratio was 14/14.
For short talks, it was 2/7
For flash talks, it was 5/5

Each session was assigned a dedicated chair, chosen among applicants who were not selected for an oral presentation.

There were two well-attended poster sessions, each lasting 2.5 hours. In addition, the poster room remained accessible until 10 pm for additional presentations and discussions. The program also left ample opportunity for informal discussions amongst the participants both at lunchtime and dinner/post-dinner time.

We also included a visit of the Ile de Batz in the program me. This provided a nice platform for further informal discussions.

Scientific program

The first evening was dedicated to a keynote lecture by Andrea Brand from the Gurdon Institute at the University of Cambridge. She gave an overview of her work that elucidated how nutrition-dependent signals control neural stem cell behavior in Drosophila. Her presentation also comprised a stimulating description of the technical advances she developed (based on the DAM methylase) to identify the transcriptional changes that accompany stem cell development. This lecture was sponsored by EMBO.

Session 1. Specifying and evolving patterns, size and shape
Chair: Vanessa Ribes (Institut Jacques Monod)

In this session, several speakers described how evolution, mechanical influence and cell behavior shape pattern in various animal models. **Antonia Monteiro**, *Singapore,* described the evolution of gene regulatory networks that control patterns, using butterfly eye spots as a model. **Nicolas Goudemand,** *Lyon,* gave us a tour of the various morphologies seen in conodonts, as deduced from fossils. He then described simple Turing models that could account for these morphologies. **Steffen Lemke** compared the mode of gastrulation in two insects, using live video microscopy. This showed that the same outcome can arise form distinct sets of cell behaviours. **Michel Labouesse,** *Paris,* demonstrated how mechanical tension originating in muscles promotes epithelial morphology. **Frederique Perronet,** *Paris*, described an original analysis of how developing tissues deal with developmental noise, using Drosophila wings as a model system. **Khila Abderrahman,** *Lyon*, showed using spectacular movies how leg morphology of water striding insects evolves in response to predation pressure. **Alain Vincent,** *Toulouse***,** described a novel type of muscles in Drosophila embryos, which could serve to position organs. At the end of this session, five students and post docs gave excellent talks on a variety of subjects related to the topics of sessions 1 and 2.

Session 2. Collective behavior
Chair: Marcus Bischoff (University of St Andrews)

In this session, speakers discussed the emergent properties that arise when cells coordinate their activities. **Jan Traas**, *Lyon*, gave an overview of the sophisticated understanding that he has gained over the years on organ shape generation at the shoot apical meristem. **Sylvie Dufour**, *Créteil*, discussed how beta-integrins and Cadherins interplay to control neural crest cell migration and the genesis of the enteric nervous system in mammals. Through her studies of Amotl2a, **Virginie Lecaudey**, *Frankfurt*, uncovered an unexpected role of the YAP and TAZ homologs on the migration of the lateral line in the zebrafish embryo. **Muriel Grammont**, *Lyon*, described the phenomenon of cell flattening in the follicle epithelium of Drosophila and used AFM as a first step towards a mechanical understanding of this process. **Denise Montell**, *Santa Barbara, USA*, gave a summary of her understanding of cell migration in the Drosophila ovary before suggesting that many cells undergo anastasis, a process whereby they come close to undergoing apoptosis before returning to full viability. **Yohanns Bellaiche**, *Paris*, described an elegant model to explain how tissue architecture specifies the orientation of cell divisions in an epithelium. **Jennifer Zallen**, *New York, USA*, uncovered a new mechanism that generates planar cell polarity in the Drosophila embryo, based on the combinatorial segmented expression of Toll receptors. This session was topped with another set of excellent flash talks by students and post-docs, on subjects related to sessions 3-5

Session 3. Self-organisation
Chair: Bénédicte Charrier (Roscoff)

In this session, speakers described the amazing patterns that can arise when groups of cells follows a set of seemingly simple rules. **Eric Siggia**, *New York, USA*, described how pluripotent human embryonic stem cells self-organise to reconstitute germ layers when they are grown on confined micropatterns. **Jeremy Green**, *London, UK*, described placode morphogenesis in mice, showing how differential mechanical resistance between cell layers could account for initial buckling of the placode. **Julianne Halley**, *York, UK*, gave broad-brushed tour of how concepts of physics and socio-biology could inform the analysis of complex DNA-binding data. **Anne-Grapin-Botton**, *Copenhagen, Denmark*, illustrated the power of live imaging of organs in culture to study stem cell behavior in situ. In the final talk, **Claude Desplan**, *New York, USA*, gave a high-energy talk on how stochastic cell fate choices ensure the right distribution of photoreceptors in Drosophila and other insects.

Session 4. Regeneration, repatterning and repair
Chair: Marc Ekker (Ottawa, Canada)

This session provided specific insight into the molecular and cellular mechanisms driving tissue and organ regeneration in adult animals upon lesion, and in cell fate decision processes during development. **Matthias Hammerschmidt**, *Köln*, described the process of re-epithelialization in the zebrafish larva and adult after a skin wound, through the mobilization, active migration and morphological adaptations of keratinocytes. This was complemented by in vivo imaging of wound detection mechanisms in this species, in a talk by **Philipp Niethammer**, *New York USA.* **Brigitte Galliot**, *Genève*, exemplified how the highly regenerative model hydra can be used in transcriptomic approaches to study epithelial plasticity, and the molecular mechanisms therein, following neuronal ablation. **Enrique Amaya**, *Manchester UK*, reported the unexpected observation that the production of ROS at the site of injury in the tadpole tail is required for regeneration, through the promotion of cell proliferation and growth factor signaling. **Michalis Averof**, *Lyon*, beautifully highlighted the technological developments recently achieved in his laboratory to film limb regeneration in situ in the crustacean Pharyale, and the identification in this species of muscle stem cells resembling mammalian satellite cells. **Elly Tanaka**, *Dresden*, highlighted how, upon tissue transplantation in Axolotl, the presence of a sectioned nerve and of a positional discontinuity in tissue identity can suffice to induce the generation of a patterned limb, and how Shh and Fgf signaling are involved in this process. **Andreas Schedl**, *Nice*, described the regeneration pathways at play following ablation of the adrenal cortex. This series of regeneration talks was followed by two selected short talks on the control of asymmetrical divisions and cell fate acquisition in embryonic neural progenitors. **Fabienne Pituello**, *Toulouse*, described how the phosphatase Cdc25b biases cell division mode of neural progenitors in the chick embryonic spinal cord to favor neurogenic divisions. Continuing on this theme, **Xavier Morin**, *Paris*, presented his thought-provoking data demonstrating that the ubiquitin ligase Mindbomb is asymmetrically recruited to the young centrosome upon asymmetrical division in neural progenitors of the mouse and chicken embryos.

Session 5. Tissue homeostasis, amplification, quiescence and apoptosis
Chair: Sam Crossman (London, UK)

This session provided a general update on the mechanisms driving cellular and tissue homeostasis in various systems while accommodating non-homeostatic events such as cell amplification, quiescence or apoptosis. **Jean-Paul Vincent**, *London UK*, described a model that could explain the pattern of apoptosis in Drosophila segmentation mutants, relying on a threshold level of EGFR signaling that follows indirectly from the segmentation cascade. Continuing on this theme of elimination of unfit cells, **Eugenia Piddini**, *Cambridge UK*, dissected the competition pathway induced by loss of expression of

Scribble, a polarity determinant. She showed how this mechanism operates through cell compaction and the up-regulation of p53. The nature of the clonal dynamics that drives cell population homeostasis was the focus of several talks. In elegant live imaging experiments, **Valentina Greco**, *New Haven USA*, highlighted this issue in the context of wound healing in the mammalian skin, showing how potentially equivalent progenitors are recruited in proliferation and migration responses. **Benjamin Simons**, *Cambridge UK*, presented a comparison of the clonal dynamics underlying the maintenance of neural progenitor pools in the embryonic versus the adult mouse forebrain, stressing the fact that embryonic progenitors display a deterministic behavior while adult progenitors rely on stochasticity. **Cédric Maurange**, *Marseille*, reported on a new tumor model whereby neural progenitors of the Drosophila embryonic nerve cord become transformed into cancer stem cells following two genetic events: the loss of expression of the *prospero* gene and the sustained expression of chinmo, the latter event being sufficient for transformation. The mechanisms involved could be relevant to pediatric tumors. **Laure Bally-Cuif**, *Gif-sur-Yvette*, reported on the homeostasis-promoting Notch3 signaling pathway in adult neural stem cells of the zebrafish pallium, and how pallium construction in this species strictly depends on the tight control of neural stem cell activity.

An impressive keynote lecture by **Olivier Pourquié**, *Boston, USA*, stimulated the last evening of the meeting. O. Pourquié discussed a novel in vitro model recapitulating oscillations of the Fgf pathway in the presomitic mesoderm, in fitting with this cell population behaving as an excitable system. He went on reporting on his recent identification of the retinoic acid pathway as a necessary pathway to buffer asymmetry-inducing systems and help generate symmetrical organs in the mouse and fish.

General comments

The total number of participants to the Conference was 95. It included 39 Principal Investigators, 34 post-docs and Research Associates and 17 PhD students. Selected applicants originated from 10 different European Countries, USA, Canada, Japan, and Singapore. The overall quality of the talks was outstanding, and the numerous questions raised after each talk lead to stimulating, lively discussions. All 5 oral sessions and 2 poster sessions were very well attended. The choice of Roscoff as a venue for this conference of the Developmenal Biology series was appropriate since it fostered informal yet rigorous scientific exchanges. The success of the conference could be judged from the request by many participants for another meeting in 3 years and from numerous “thank you’ emails that we received after the conference. The growing momentum of systems biology provides a strong impetus to organize this conference every 3 years. Care should be taken to avoid overlap with the Developmental Biology Gordon Conference. Laure Bally-Cuif, vice-chair will chair the next conference, to be held in 2018 pending approval by the CNRS. She will be seconded by Claude Desplan, NYU, New York City, USA, who was co-opted as the next vice-chair.