The past and present of planarians -
An interview with Vittorio Gremigni

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ABSTRACT Vittorio Gremigni is a scientific leader in the field of planarian biology with a very long historical perspective. By using electron microscopy, he contributed to the reconstruction of the phylogenesis of free living “Turbellaria”, and he pioneered the study of the origin of blastema cells by using chromosomal markers. In this interview, Professor Gremigni describes the steps that moved his career towards the planarian field, the main scientific achievements he obtained and the changes that are taking place in the field. He also discusses recent progress and unanswered questions on planarian neoblasts and regeneration.

KEY WORDS: Vittorio Gremigni, planarian

Introduction

We are particularly pleased to write this interview as, a few months ago, Vittorio Gremigni retired from his long academic and scientific career. Thus, this interview provides us with the opportunity to say thanks to him for his scientific, as well as personal, constant support. In the planarian field, Vittorio Gremigni is probably one of the scientists with the longest historical perspective. He started studying planarians since his graduation thesis and approached this system through different methodologies. He answered several different questions, ranging from the systematics and phylogeny of Platyhelminthes, to the origin of blastema and the biology of neoblasts.

How did you decide to study planarians?

The destiny of my scientific career was decided in the first half of the sixties (XX century) when, following a brilliant examination, Professor Benazzi, an international authority in the field of planarian biology and cytogenetics, asked me to attend his lab to prepare my thesis. In fact, a few days later, I began my research experience with his wife Giuseppina Benazzi-Lentati studying the oogenesis of the freshwater Triclad *Dugesia*, where I found that meiotic oocytes (at that time considered totally alecithal) unexpectedly contain a small amount of proteinaceous yolk globules. The next step was to extend this type of investigations to other, mostly free living, Platyhelminthes, including both the so-called “archoophora” and “neopohora” through an electron microscope approach.

Only a few years after my first entry in Benazzi’s Institute, following a careful reading of the comprehensive book by H.V. Brøndsted (Brøndsted, 1969) and other reviews and original articles on the topic, I was attracted by the controversial and fascinating problem of planarian regeneration. I planned some experiments thanks to the availability in Benazzi’s aquarium of some peculiar biotypes of the planarian *Dugesia* characterized by different chromosome sets in different cell populations (a very useful cell marker). In particular, I chose a triplo-hexaploid biotype of the sexual planarian *Dugesia polychroa* with triploid neoblasts, embryonic and somatic cells, diploid male germ cells and hexaploid female germ cells.

How did electron microscopy and other ground-breaking techniques transform your approach to research in the planarian field?

About fifty years ago the electron microscope technique had a great impact on the study of cell, tissue, and organ morphology, and opened a new scenario in the systematics and phylogeny of Platyhelminthes, as well as many other organisms. In my opinion, however, ultrastructural investigations were less relevant in the approach to planarian regeneration, even though they had the merit to clarify some important black points, one for all to deny the hypothesized syncytial nature of the parenchyma. The main road to obtain clear answers to the numerous questions still open in those years on the complex process of planarian regeneration was to revisit the classical experimental procedures of the first fifty years of the century: transection, grafting, X-ray treatment and so on - in particular with the aid of molecular biology techniques, an approach that some years later my dear friend Jaume Baguñà undertook successfully.
and very beginning of the eighties, were welcomed with very good comments by the international scientific community (not only planarian researchers). Unfortunately, I could not support my findings and suggestions with molecular data as I would have liked in those years. However, I am very happy and proud that at the very beginning of this century, this goal has been reached thanks to the admittance in my lab of two young, well learned researchers, Alessandra Salvetti and Leonardo Rossi (with other numerous Ph students) whom I thank so much also for this interview. Thus, my new research group dealt with the identification and characterization of several neoblast molecular markers, and designed and produced the first planarian microarray platform thanks to which we identified a neoblast molecular signature (Rossi et al., 2007). One of the most interesting neoblast genes that we have studied is DjPiwi-1, that was one of the first markers for a specific neoblast subpopulation of D. japonica to be identified (Rossi et al., 2006). Indeed, Djpiwi-1 is uniquely expressed in a group of neoblasts clustered along the dorsal body midline, preferentially anterior to the pharynx. This exclusive localization was an unexpected surprise, and paved the way to other pieces of evidence supporting neoblast heterogeneity. Indeed, we further contributed to this topic by the identification of neoblast subpopulations with different levels of tolerance to X-ray treatment (Salvetti et al., 2009).

What is your estimation of the changes taking place in the field of planarian stem cells and regeneration?

The entrance into the field of planarian studies of brilliant young scientists that established new, well-funded research groups has revolutionized planarian research, bringing new excellent results to the scientific community. In recent years, several genes involved in neoblast maintenance, proliferation and differentiation have been identified, thanks to the breakthrough of new methodologies and planarian genome sequencing, thus fostering planarians as one of the most appealing model systems for stem cell and regenerative medicine research (Sánchez Alvarado, 2007; Rossi et al., 2008;...
The percentage of pluripotent neoblasts is still unknown. Second, although the aforementioned paper by the Reddien group suggests that pluripotent stem cells are spread throughout the ventral parenchyma, more precise information on the spatial distribution of these cells in physiological conditions is needed. The third unanswered question is strictly correlated to this point, and concerns the neoblast niche. No information is indeed available about signals that control neoblast fate. We suggested a role for neural signaling in the repopulation process that follows low dose X-ray irradiation (Salvetti et al., 2009 and Rossi et al., 2012). However, direct evidence for a role of the nervous system in neoblast regulation is still missing. I am sure that these questions will be answered in the next future, thanks to the upcoming technologies and the strengthened collaboration between planarian labs, that will allow the sharing of knowledge and expertise.

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