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## OBITUARY

### Janine Beisson, Pioneer of Cytoplasmic Heredity

(June 9, 1931, Saïda – August 30, 2020, Mégève)

Linda Sperling<sup>1</sup>

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Born Janine Schecroun in French Algeria, Janine survived Nazi occupation (the family fled the Paris region to Algeria in 1940) and tuberculosis (while at University) and was doing fine dodging the current COVID pandemic until the car in which she was touring the French Alps crashed into a ravine last Sunday.

After obtaining diplomas in both natural sciences and literature, Janine turned to the “new” discipline of Genetics (the first University Professor of Genetics in France, Boris Ephrussi, was appointed at the Sorbonne only in 1945!). Janine prepared her doctorate in the laboratory of Georges Rizet, first at the IBPC (Rothschild Institute in Paris) then on the Gif-sur-Yvette CNRS campus. Her brilliant genetic analysis of the “barrage effect” in the filamentous fungus *Podospora anserina* firmly established the phenomenology of this intriguing example of cytoplasmic incompatibility, shown decades later, by Sven Saupe and colleagues in Bordeaux, to involve a prion. Janine was recruited as a full-time CNRS researcher before the end of her thesis, and also took part in University teaching.

In 1962, Janine married Georges Beisson and joined the laboratory of Tracy Sonneborn, in Bloomington Indiana, mecca of cytoplasmic heredity. In Bloomington, she studied non-Mendelian inheritance in the ciliate *Paramecium*, a microscopic freshwater organism whose surface is covered by rows of cilia, essential for locomotion as well as feeding and sexual reproduction. She showed that a trait acquired by micro-surgery – the inversion of a row of cilia on the cell surface – could be inherited across cell divisions and sexual generations. Named ‘cortical heredity’ or ‘cytotaxis’, the phenomenon became a paradigm for heredity relayed by cellular structures (hence related to prions) rather than nuclear genes.

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Janine returned to France in 1964 and was able to set up her own *Paramecium* genetics group within Rizet's laboratory at the University of Orsay, down the road from Gif. Her team moved to the Centre de Génétique Moléculaire (CGM) on the Gif CNRS campus in 1972, when she accepted the Direction of one of the three departments of the Center upon the retirement of the former department chair, Boris Ephrussi.

Janine's group used the classical genetic approach of isolation and analysis of mutants to study cytoplasmic heredity. First, mitochondrial heredity and nucleo-mitochondrial interactions in the 1970s. This fit well with the CGM's strength in yeast mitochondrial genetics, the subject of the Center's director Piotr Slonimski, who became a life-long friend. *Paramecium* mitochondrial genetics was however abandoned after the PhD theses of André Adoutte and Annie Sainsard-Chanet.

The team could then concentrate efforts on the study of cortical heredity. Amazing mutants were isolated on the basis of cell shape, cell size and swimming trajectory that showed defects in the morphogenesis of the cell cortex. This was possible because the cortex is covered by thousands of motile cilia arranged in a precise pattern. The cilia grow from thousands of cortical basal bodies which organize the complex cortical cytoskeleton. During the 1980s Janine's group developed methods for immunocytochemistry of the cytoskeleton as an indispensable tool to characterize the mutants, and established the chain of morphogenetic events involved in vegetative cell division, when the precise surface pattern is restored in the daughter cells after binary fission.

Although there clearly were transcellular signals that controlled the duplication or elongation of the different structures, Janine and her colleagues, PhD student then CNRS researcher Jean Cohen, research associate Françoise Ruiz, André Adoutte and colleagues in Orsay, and Maria Jerka-Dziodosz from the Nencki Institute in Warsaw, were staunch proponents of the importance of local events that relay cortical morphology. In other words, Janine considered that local molecular interactions -- as opposed to long-range reaction-diffusion effects first modeled by Alan Turing -- were the major determinants of pattern formation in *Paramecium*.

Janine began every day of her career by starting an experiment. During the years of her administrative responsibilities as Department Chair, she did not always finish the day's experiment. This changed for the better over the twenty happy years (1998-2018) she spent in the lab as Emeritus research director, freed of the tedium of administration. During this period, she had the joy of finally discovering the molecular identity of the genes behind the network of morphogenesis mutants and suppressors, most notably genes encoding known and novel tubulins ( $\gamma$ -,  $\delta$ -,  $\eta$ -, ...). She also developed, with colleagues Catherine Klotz, Luisa Madeddu, Delphine Gogondeau and France Koll, an entirely new subject involving a cortical lattice composed of centrin proteins, small calcium-binding contractile proteins ancestral to the actin/myosin based motility that prevails in multi-

cellular organisms. Those beautiful studies were a fertile substrate for developing ideas about pattern formation.

Janine's long career allowed her to participate in and benefit from *Paramecium* genome sequencing in the opening years of the 21<sup>st</sup> century. The genome annotation revealed why it had not been possible to saturate a function of interest with mutations to achieve complete genetic dissection: the *Paramecium* genome was shaped by a succession of ancient whole genome duplications, and many genes are still present in two or more redundant copies.

The school of French *Paramecium* geneticists Janine had founded also tackled and eventually solved the long-standing mystery of non-Mendelian inheritance of *Paramecium* mating types. Janine followed with great interest all the steps of that adventure, from genetic studies in her laboratory in the 1970s to the recent demonstration, by Eric Meyer and colleagues in Paris, of the key role of small RNAs in mating type determination.

Janine devoted her life to research. But she also enjoyed, with her husband Georges, being a licensed airplane pilot, often flying herself to meetings or vacation spots in Europe and Northern Africa. Her literary talent made her an avid reader of English and French classic and contemporary fiction and allowed her to publish beautifully written papers and a book about Genetics in the collection "Que sais-je?".

Link to generate a list of Janine's publications using PubMed:

[https://pubmed.ncbi.nlm.nih.gov/?term=Beisson+J+OR+Schecroun+J+OR+BeissonSchecroun+J&sort=pubdate&sort\\_order=asc](https://pubmed.ncbi.nlm.nih.gov/?term=Beisson+J+OR+Schecroun+J+OR+BeissonSchecroun+J&sort=pubdate&sort_order=asc)

