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**André LWOFF (1902-1994): The Man, The Scientist, The Friend,  
The Artist.**

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**Abstract:** The life of André Lwoff, winner of the Nobel Prize in Physiology and Medicine, as a scientist, a man, a friend and an artist, is commented on here in the light of the works that have been devoted to him, his own writings, personal memories and anecdotes of the author. This French scientist, was first internationally recognized for his work as a protistologist. After describing many new families, genera and species of protists\* as well as their life cycles, he delved into his material of choice, the marine Ciliates, several concepts of morphogenesis, genetic continuity and sometimes regressive evolution. Then, at the end of the thirties, André Lwoff became one of the leaders in the biochemistry and physiology of protists just before he turned towards microbial physiology when he became in 1938 the Director of the Microbial Physiology Department of the Pasteur Institute. He made four major contributions to microbiology : First, he investigated the effects of growth factors, especially vitamins on the development of bacteria. The second was the discovery of the induction of lysogeny in which a bacterial virus (bacteriophage) infects bacteria and is transmitted to successive generations by cell division of its host, one of the major discoveries in the development of microbiology in the XX th century. The third major contribution began in 1954 when André Lwoff performed a series of experiments on the temperature sensitivity of viral development (poliovirus), and showed that the virulence was linked to the ability of the virus to multiply at high temperature. The fourth major accomplishment was his chairman-ship of an international panel in 1962 that proposed a logical and unified nomenclature of viruses, and resolved their anarchic taxonomy.

\* *single-celled organisms carrying all functions of the living*

**Key words:** André Lwoff, Nobel Prize, the man, the scientist, the friend, the artist.

## **Introduction**

Much has already been written about the life and scientific career of the great scientist André Lwoff (1902-1994), founder of bacterian genetics, who won the Nobel Prize in Physiology and Medicine (1965) with Jacques Monod and François Jacob for their work on the control of the gene expression. His work was reported in the homage book “Of Microbes and Life” edited by his friends Jacques Monod and Ernest Borek, 1971 <sup>13</sup>, then by his own writings assembled in the book « Games and Fights », 1981 <sup>6</sup>, summarized by M-O Soyer-Gobillard, 2016 <sup>15</sup> and recently promoted by Laurent Loison, 2017 <sup>5</sup>. In this article, the author recalls the key points of Lwoff’s scientific career and his main discoveries. From more personal memories, she adds a few touches to the portrait of the one who was her last Master.

## **The Man and the Scientist**

André Michel Lwoff was born on the 8th of May in 1902 at Ainay-le-Château (Allier, France). He inherited from his father (Salomon Lwoff), physician and practising psychiatrist, an inclination for hard work and independent thought. His mother, Marie Simionovitch, was a sculptress and also the cousin of the famous Russian painter Valentin Serov (1865-1911) who made her portrait in 1895, now on display, after a donation by the Lwoff brothers, at the National Museum of Orsay in Paris. He entered the Pasteur Institute of Paris, as recipient of his own research fellowship in 1921. Successively assistant (1925), head of Laboratory (1929), and Doctor of Medicine in 1927, André Lwoff was awarded Doctor of Sciences in 1932 for his thesis on the nutritional biochemistry of free-living and symbiotic protozoa. From 1920 he spent holidays at the Marine Biological Station of Roscoff (British Channel) where, in 1921, he met Edouard Chatton. The famous protistologist became his mentor and his friend. Their collaborative work on the study of ciliates and other protists continued every summer in Roscoff, Banyuls-sur-Mer or Sète (Mediterranean coast) until the death of Edouard Chatton in 1947.

Edouard Chatton, Master Lecturer at Strasbourg University, sought a collaborator to assist him in his research at the Roscoff zoological station. In addition, he also was assigned to recruit a qualified assistant for the Pasteur Institute of Paris. Collaboration began immediately between Chatton and Lwoff in the summer of 1921 and after one year, their first joint paper was accepted to be published in the “Comptes Rendus de l’Académie des Sciences” on a new

family of acinetan ciliates. This meeting decisively launched André's career. A close, very friendly and extraordinarily productive relationship of pupil to master began. Of the 151 publications by André Lwoff in protistology, 55 were written in collaboration with Edouard Chatton. Both men felt a profound love for marine biology especially protists and their collaboration continued in Roscoff and Banyuls-sur-Mer, Sète and Wimereux (North of the British Channel), Chatton with his scientific rigor being an incomparable instigator of new scientific discoveries<sup>14,12</sup>. In their study of Mediterranean marine protists and animals, Chatton and Lwoff, with their remarkable observation skills, identified numerous single-celled organisms and analysed their life histories. Much of their research was on Apostome ciliates from Banyuls and particularly notable is their monograph on this group published in 1935<sup>1</sup>. These symbiotic protists ciliates have two hosts; they develop in crustaceans and then in cnidaria (sea anemones). They undergo remarkable metamorphosis when they move from the first to the second host. The Chatton-Lwoff's work on these particular ciliates led them to propose the rule of "desmodexy": in ciliates, the kinetodesmal fiber is always located on the right of the kineties (rows of kinetosomes), where it links the kinetosomes, the structures in some flagellate protozoans that form the base of the flagellum or cilium. They also hypothesized the genetic continuity of the kinetosomes.

André Lwoff was appointed as a research assistant at the Pasteur Institute of Paris in 1925. He began to publish alone or with other colleagues. Marguerite Lwoff, wife of André, a pleasant woman, began to work with André and Chatton as a close collaborator in 1929. She later became "laboratory director" at the Pasteur Institute. In 1925, Lwoff began to publish alone results included in his doctoral thesis on nutrition including metabolism of sugar and other solutes by ciliates and other protists. In fact, André Lwoff continued to collaborate with Edouard Chatton on studies of marine protists for many years, until Chatton's death in 1947 in Banyuls. Chatton and Lwoff identified numerous unicellular organisms in the Mediterranean sea. They described and analyzed morphology, life history, ecology and accumulated many discoveries. In a synthetic article published in 2003 in the "Protist" journal, Marie-Odile Soyer-Gobillard and Joseph Schrevel<sup>16</sup> brought together all Lwoff's protistology work, published alone or in association with Chatton or other authors, totalling 151 publications.

Lwoff's investigations on the "growth factor" of flagellates and ciliates led him to work on bacteria. With support of the Rockefeller Foundation, Lwoff worked a one year (1932-1933) in Heidelberg (Germany), in the laboratory of Otto Meyerhof, biochemist, Nobel Prize winner in

Physiology and Medicine in 1922. In 1936, with his wife Marguerite, André Lwoff spent seven months in the laboratory of David Keilin, biochemist (where they worked on cytochromes) at Cambridge University in Great Britain (The United Kingdom). Next, André Lwoff was appointed director of the newly (created for him) Department of Microbial Physiology at the Pasteur Institute, (Paris) in 1938 and remained there until 1968. When his studies of nutrition and growth factors in bacteria led him to investigate bacteriophages, prophages and other viral particles, all studies in which he was as brilliant and innovative as in protistology. Just after the death of Chatton, Lwoff published in 1949 their monograph on *Thigmotrich ciliates* <sup>2</sup>, the second part in 1950 <sup>3</sup>. He also taught about protists at the Harvard Medical School in Boston, Massachusetts in United States at regular intervals from 1947 until 1950.

André LWOFF was awarded the Nobel Prize in Physiology and Medicine, 1965, which he shared with François Jacob and Jacques Monod. At the origin of bacterial genetics, when he contributed enormously to the study of bacteria, viruses and bacteriophages, many scientists were unaware that he was already a great protistologist. Lwoff also made major contributions to studies on lysogeny <sup>7</sup> (one of the two types of viral reproduction), improving knowledge on bacteriophages <sup>11</sup> and thermolability of viruses <sup>9, 10</sup> and on the factors that influence viral diseases such as carcinogenic agents that induce provirus to virus transformation <sup>8</sup>. Lwoff this way strongly influenced medical research in the study of cancer.

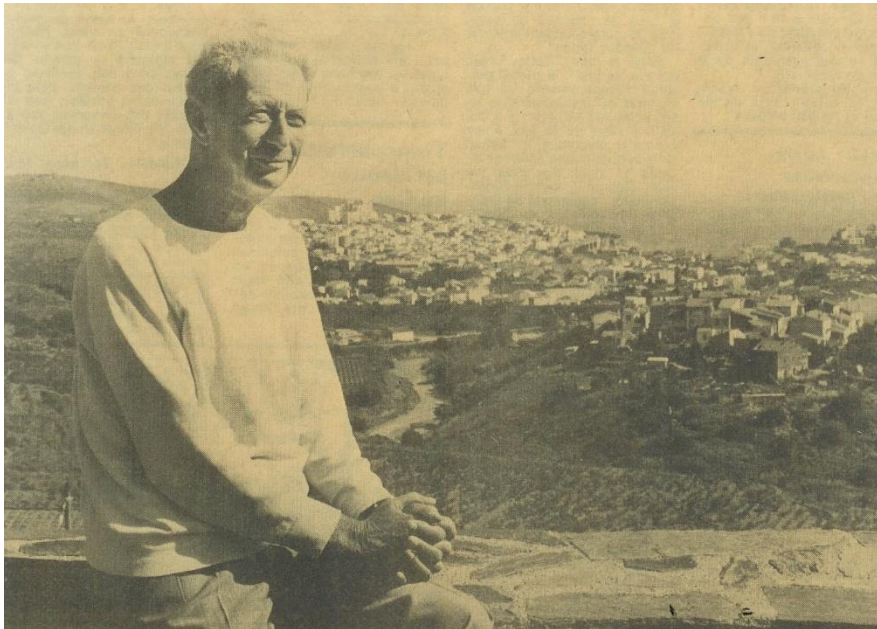
He was honoured by - Grand Croix of the Légion d'Honneur, - Resistance Medal, - Commander of the Academic Palms, - President of the French Movement for Family Planning (1970-1974). André LWOFF was also President of the International Association of Microbiology Societies, and was a member of the International Committee for the Organization of Medical Sciences. He also was a member of numerous french and foreign scientific societies: Zoological Society of France, Society of Exotic Pathology, Society of Biology, President of the French Society of Microbiologists, Harvey Society, American Society of Biological Chemists, Society for General Microbiology, Botanical Society of America. He received honorary doctorate degrees from the following universities: Chicago (1959), Oxford (1959), Glasgow (1960), Louvain (1966), Liège (1967) and Bruxelles (1970).

In the chapter XXXVII, entitled "The big and positive things", taken from his scientific autobiography, introduced, published, and remarkably annotated by Laurent Loison in 2017 <sup>5</sup>, André Lwoff revealed that in addition to his passion for scientific research, he had other activities that were not scientific. Thus, writing : he published many of his texts in his book *Jeux et Combats (Games and Fights)*, 1981 <sup>6</sup>. He also participated in the campaigns of various

groups against racism and anti-semitism and in the defense of the state of Israel. President of the French family planning movement, he was also a member of the Advisory Committee of the World Health Organization (WHO). He also created the Pasteur-Weizmann Council, to develop relations between the Institut Pasteur and the Weizmann Institute of Sciences located in Rehovot, Israel.

### **The Friend**

With his Nobel Prize André LWOFF was able to acquire in Banyuls-sur-mer the old fortress of Jacques 1er of Aragon (1208-1276), in the heights of Banyuls, among the vines, cork oaks and almond trees with a stunning view on the Vermilion Coast and the Mediterranean Sea. He stayed there several months of the year, in the summer, often receiving friends and scientific visitors from the Arago Laboratory (Figure 1).



**Figure 1.** André Lwoff facing the Bay of Banyuls-sur-mer (Mediterranean coast) in 1978, sitting on a wall of Mas Guillaume, his home in Banyuls. Cliché Journal “the Independent”, Catalan (news)paper from Perpignan.

I met André LWOFF in August 1970. Coming to examine my thesis work, recently defended, he wanted to entrust me with a particular job: that of completing the scientific work left unfinished by his deceased Master Chatton. This is how in 1973, I co-signed a posthumous article with Edouard Chatton<sup>4</sup>. Prefaced by André Lwoff, we described the biological cycle of a particular Protist, *Paradinium poucheti*. Coelomic parasite of planktonic copepods (crustaceans), it is classified as Mycetozoa. I added the description of two species, new for science. During five years, I was Vice President of the National Committee of the C.N.R.S.

(French National Center of Scientific Research), number 28 (Biology of the Organisms and Development), its President being Jules Hoffmann, who has since won the Nobel Prize of physiology and medicine for his pioneering work on the origins of the immune system. Several annual sessions brought the commissioners together to judge and advise the French Research Laboratories and their researchers who depended on our section of the National Committee. Throughout this period André Lwoff housed me in his Paris apartment, allowing me to enjoy his scientific experience and his immense scientific, musical and artistic culture.



**Figure 2.** André Lwoff, Nobel Prize winner, opposite the couple Professor Jacques Soyer, formerly Director of the Laboratory Arago, Banyuls-sur-mer and Dr. M-O. Soyer-Gobillard during her appointment to the rank of Research Director (1975). Personal archive of M. O. Soyer-Gobillard.

When he went down to Banyuls in the summer, he often came to visit us in my Laboratory of Marine Cell Biology at Banyuls-sur-Mer (Sorbonne University, Paris 6), and introduced us to techniques of isolation and selection of Protist Ciliates, or participated in our meetings and feasts, many at this time (Figures 2, 3). One day he arrived at my Laboratory with a piece of a kind of cloth that he said belonged to a pair of slippers. When he wore these slippers, he had severe itching and pricks. He asked me to find out what the composition of this fabric was. Perplexed, I decided to burn it in a cup on a Bunsen beak. What was our surprise when we collected multiple glass needles at the bottom of the cup. The "fabric" was woven glass wool! We affectionately nicknamed him "The Man with the Glass Slipper" (a play on words phonetically related to the story of Cinderella and the « Vair » (fur) slipper : « glass » means

« verre » in French). He made a statement of his misadventure which was published on the front page of the Daily (news)paper "Le Monde" signed by the medical journalist of the time.

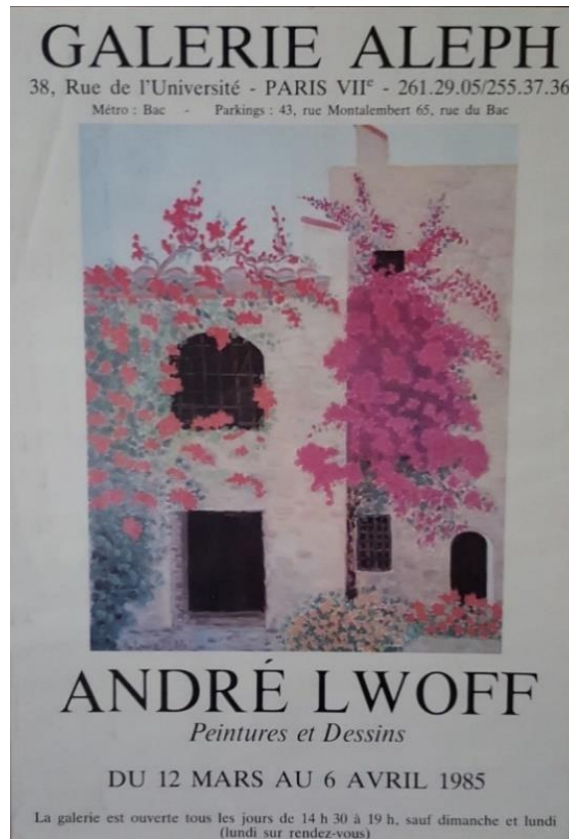


**Figure 3.** André Lwoff at left and Professor Jacques Soyer in the City Hall of Banyuls-sur-mer visiting the first exhibition organized (24-05-1979) by M-O Soyer-Gobillard in the honor of the master Edouard Chatton, during a Meeting of GPLF (Group of French Language Protistologists). Personal archive of M. O. Soyer-Gobillard.

### **The artist**

Still according to his autobiography edited by Laurent Loison <sup>5</sup>, Lwoff tells of his love at first sight for painting, which came late, at the age of 57. He was initiated by a doctor and artist friend, Marcelle Wahl, whose dry tips and etchings are on display at the Louvre Museum Paris. He developed this new passion, arrived at the age of retirement, and his paintings, still lifes and landscapes were sublimated by oils, pastels or gouaches. Three successful exhibitions took place in Paris (Figure 4) and the proceeds from their (numerous) sales were donated to the Pasteur-Weismann Foundation in Rehovot (Israel).





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**Figure 3.** Poster announcing a Lwoff paintings exhibition in Paris (1985) and representing the “Mas Guillaume”, home of André and Marguerite Lwoff in Banyuls-sur-mer (France).

André Lwoff, whose mother was a sculptress, made a few incursions in that art form, creating four bas-reliefs and a bust. His Masters Edouard Chatton and Felix Mesnil, represented by Lwoff and cast in bronze can be seen at the Institut Pasteur (Paris) alongside the great pasteurians. Of this exceptional and rigorous personage, we can remember that his life, as he defined it himself, was a long series of Games and Fights, on which he always kept a look at once ironic, astonished and sincere.

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## Declaration of interest

The author declares she have no competitive financial interest concerning this article.

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## Short Author Biography

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Doctor of Science (Cell Biology), Honorary Emeritus Research Director at CNRS, laureate of several scientific awards, and author of 160 publications in peer-reviewed scientific journals. Former Director of the Department of Cellular and Molecular Biology (UMR 796 “Models in Cell and Evolutionary Biology”) at the Arago Laboratory (Sorbonne University) and expert at the National Agency for Research (ANR). National president of HHORAGES- France (Stop to Artificial Hormones for Pregnancies) and president of its Scientific Council, she is also a Member of the Committee of Clinical Project Reviewers (INSERM, Paris). From the year 2000, she became also ...sculptress!

## Legends of the figures

**Figure 1.** André Lwoff facing the Bay of Banyuls-sur-mer (Mediterranean coast) in 1978, sitting on a wall of Mas Guillaume, his home in Banyuls. Cliché Journal “the Independent”, Catalan (news)paper from Perpignan. Personal archive of M. O. Soyer-Gobillard.

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