OCTOBER 2020

#7

Atelier Luma Algae Review

9-10.12.2020
Arles

Within Atelier Luma, the Algae Platform is a transdisciplinary research project and knowledge platform focused on algae. By exploring the multiple histories, representations and uses of algae, by questioning the scientific, territorial and cultural stakes around algal resources, and by promoting a holistic approach, the Algae Platform strives to highlight innovative ways of valorising algae. How can algae be used as a transitional tool for bioregions?

In order to present the work undertaken so far and to initiate new research perspectives, **the Algae Platform is organising the Algae Summit on December 9th and 10th, as part of the second edition of Luma Eco Days.** Attendance at the event in Arles will be by invitation and will also be accessible virtually online.

Bringing together aquaculturists, scientists, designers, theoreticians, industrialists and local authorities, the Algae Summit aims to bring out innovative scenarios for a local and biosourced economy that is respectful of living things.

ATELIER LUMA ALGAE REVIEW

Everything you always wanted to know about algae

The algae review is a curated newsletter dedicated to algae knowledge and Atelier Luma's Algae Platform activities. By mapping existing algae knowledge — from literature to scientific research — Atelier Luma aims at consolidating a community of international algae practitioners, creatives and experts to actively participate in the research, understanding and valorization of algae resources.

"Generally speaking, objects seem to lose their importance as they become smaller and smaller; and the commoner will never convince himself that the insect he is trampling at his feet holds a rank as considerable in the metaphysical order of beings as the whale and the elephant (...). The few attractions offered to the scientists by a large number of productions that are called cryptogams*, which, by their extreme smallness, become indistinguishable from one another and seem to escape observation, has undoubtedly been the cause of the little progress of this part of Natural History."

— Justin Girod-Chantrans, Recherches Chimiques et Microscopiques, 1802

Justin Girod-Chantrans (1750-1841) was a French military man, politician and naturalist, and he is considered to be one of the fathers of French phycology.

**Cryptogams are plant organisms whose reproductive systems are not visible; in particular they do not produce flowers.*

DOMESTICATION OF THE LIVING

Collecting, preserving, exploiting, representing

The western naturalist tradition has led humans to collect living organisms, to classify them in the great table of living things and to study their methods of growth and reproduction. Science, but also the arts, industry and agriculture contribute in their own way to this effort to understand, represent and control living things.

We propose here to compare this logic of the domestication of living things with the case of algae, and more particularly microalgae; they were only relatively recently discovered, at the turn of the 18th century, and in general were long neglected by the scientific world. Their domestication is still in its infancy.

COLLECTIONS OF MICROALGAE AT THE NATIONAL MUSEUM OF NATURAL HISTORY IN PARIS

With thanks to Claude Yepremian, Sahima Hamlaoui and Charlotte Duval of the National Museum of Natural History.

The National Museum of Natural History in Paris (MNHN) cares for some 1500 strains of cyanobacteria and microalgae, which is the largest collection of freshwater phytoplankton in France. This collection is in line with the naturalist approach of aiming to catalogue animal and plant diversity, however, it is significant in this case that it concerns living organisms.

In 1928 the MNHN of Paris acquired a collection of freshwater microalgae, completed in 1997 with another of cyanobacteria. These living collections contribute to the cartography of the living and make the MNHN one of the guardians of algal diversity. The collections also have more utilitarian interests such as the conservation of important strains or the study of compounds of interest.

The constitution of a biological collection is an essential part of the wider effort to domesticate living organisms, which in this case involves two crucial stages according to Claude Yepremian, head of collections at the MNHN: isolation and perpetuation.

Isolating an identified organism may seem a simple task for plants, but it is far less obvious for unicellular organisms that typically cohabit with bacteria, fungi, or other organisms. Conventional practices seek to obtain an axenic culture, that is to say a pure culture free of parasites.

Perpetuating — or maintaining — a strain consists of conserving a representative of a biological sample and, a challenge in itself, keeping it stable over time. The speed of reproduction of microalgae and the risks of contamination or genetic evolution do not make this an easy task. The MNHN maintains the strains in a liquid medium, which requires a transplanting operation every two months, the aim of which is to dilute each culture in order to keep them perpetually in a growth phase.

Not all the diversity of microalgae can be cultivated and this is indeed a selection criterion: the cultivability of the algae dictates whether or not it should be kept in the collection. Recalcitrant algae therefore escape this domestication process.

If until this point purity and durability were the vital words, the management of collections is now evolving beyond this. There is a growing recognition of the crucial role of interactions between organisms in ecosystems. Just as a human being cannot be dissociated from all its microscopic occupants (the microbiota), a strain of microalgae is accompanied by a set of organisms that play an equally fundamental role in the survival of the strain. As such, the collection, initially thought of as a list of independent entities, could become a set of miniature ecosystems teeming with information on the web of life.

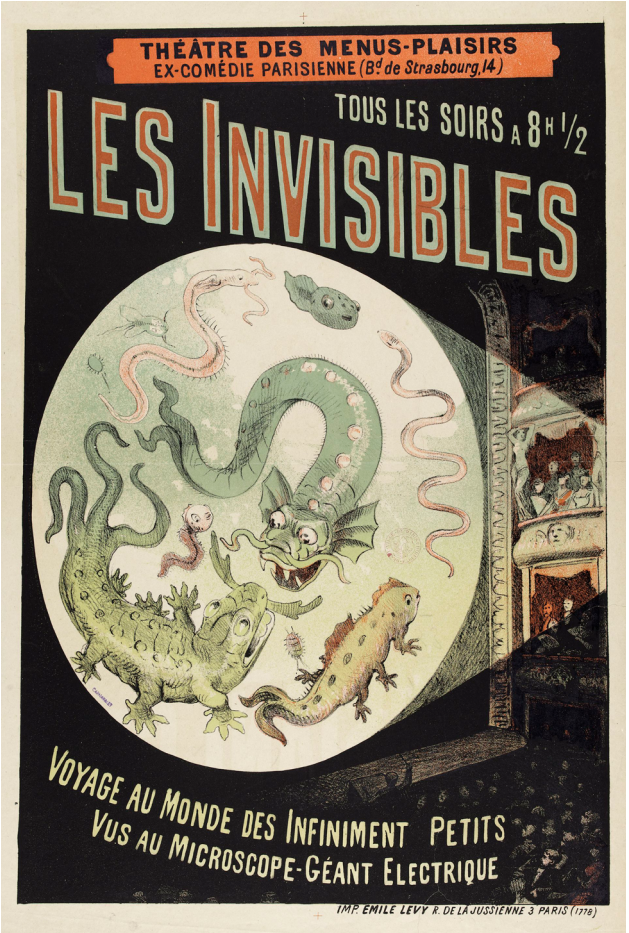
The conventional paradigm of the classification and referencing of living things by humans, which has been in force until now, is gradually being called into question as a more holistic vision of the biosphere progresses. Alongside this, the organisation of collections and the definition of the cultures within them are being revisited.

WHEN THE MICROSCOPE UNVEILED A NEW WORLD

The invention of the microscope opened the doors to a hitherto unknown world: the infinitely small.

Antoni van Leeuwenhoek (1632-1723), a Dutch cloth merchant based in Delft, is credited with the first microscope. Leeuwenhoek, who was already using magnifying glasses to check the quality of his fabrics, designed a system with an extremely simple configuration allowing him to obtain magnifications of up to 300 times for a resolution of 1.5 microns, and to discover microalgae, bacteria and even spermatozoa. Observing the movement of microalgae with the use of their flagella, he called them «animalcules», thinking he was observing animal organisms. These discoveries put an end to the theories of spontaneous generation which claimed that life could randomly appear in or on non-organic matter.

This work paved the way for the development of microbiology, which was to take off in the 19th century. It was discovered that a single drop of water was populated by a myriad of microorganisms and the invisible world fascinated as much as it frightened. Imagination took hold of these discoveries and a genre called the «marvellous scientist" appeared. In 1883, a show attracted crowds in Paris by projecting enlarged images of organisms present in the Seine. Literature was also confronted with this new reality. The tale «The Drop of Water» by the Danish Hans Christian Andersen testifies to this desire of the arts to explore scientific progress in order to construct a new aesthetic.



"You know, surely, what the microscope is — that wonderful little glass which makes everything appear a hundred times larger than it really is. If you look through a microscope at a single drop of ditch water, you will see a thousand odd-looking creatures, such as you never could imagine dwelled in water. They do not look unlike a whole plateful of shrimps, all jumping and crowding upon each other. So fierce are these little creatures that they will tear off each other's arms and legs without the least mercy, and yet after their fashion they look merry and happy."

— Hans Christian Andersen, The Drop of Water, 1848

SOURCES

→ LEEUWENHOEK'S 'ANIMALCULES', JUST AS HE SAW THEM 340 YEARS AGO • BY ANDY COGHLAN, 20 MAY 2015

→ LE «MERVEILLEUX-SCIENTIFIQUE», ANCÊTRE DE LA SCIENCE-FICTION• BY HÉLÈNE COMBIS, 24 APRIL 2019

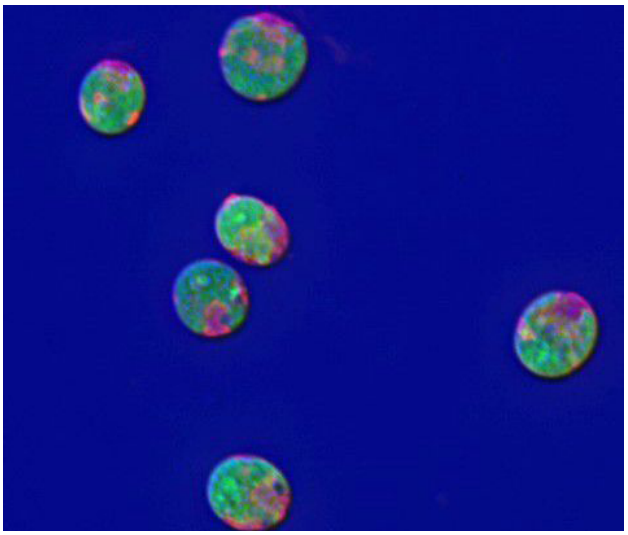
INDISPENSABLE LABORATORY GLASSWARE

Glassware is indispensable for any form of laboratory handling. The glass is resistant to high heat, does not wear out and is easily sterilised.

In 2012, the University of Lorraine in France decided to invite a glassblower to bring a former glass workshop back into service. Whereas in the recent past, glass orders have been placed with outside companies, the university now turns once again to the workshop for the production of the glass parts and — importantly — their repair. The workshop is also working on the production of custom-made prototypes for laboratory research purposes.

The origin of research equipment, which is often overlooked, deserves more attention at a time when production is being examined and relocated.

SOURCE
→ A LA DÉCOUVERTE D'UN ATELIER DE VERRERIE À L'UNIVERSITÉ DE LORRAINE • 9 APRIL 2015



GENETICALLY MODIFIED ALGAE

Algae offer interesting prospects for a whole range of applications but remain relatively expensive to cultivate. Industrialists are therefore selecting species capable of producing more biomass (or a specific compound) under given conditions. Stephen Mayfield, a biologist at University of California San Diego says: "We need to domesticate algae, just as we have done with our crops and farm animals. But that could take decades and we're not sure we're going to get what we want."

Genetic selection is one thing (what about the loss of genetic diversity in algae?), but genetic manipulation is another — with potentially much more serious consequences. Huge advances in biotechnology have made it relatively easy to manipulate the genetic material of living organisms. All of the promises that genetic engineering bring in terms of food and energy security do not erase the valid questions that are being raised. What is the risk for the environment, taking into account the easy dispersal of microalgae in aquatic and aerial environments? Several studies attempt to demonstrate that the introduction of genetically modified populations into a territory is harmless. But even if this is proven to be true, what about the ethical questions concerning the manipulation of living organisms?

SOURCE
→ GENETICALLY MODIFIED ALGAE COULD SOON SHOW UP IN FOOD, FUEL, AND PHARMACEUTICALS • BY MARLENE CIMONS, 4 MAY 2017

REVEALING THE BEAUTY OF MICROALGAE

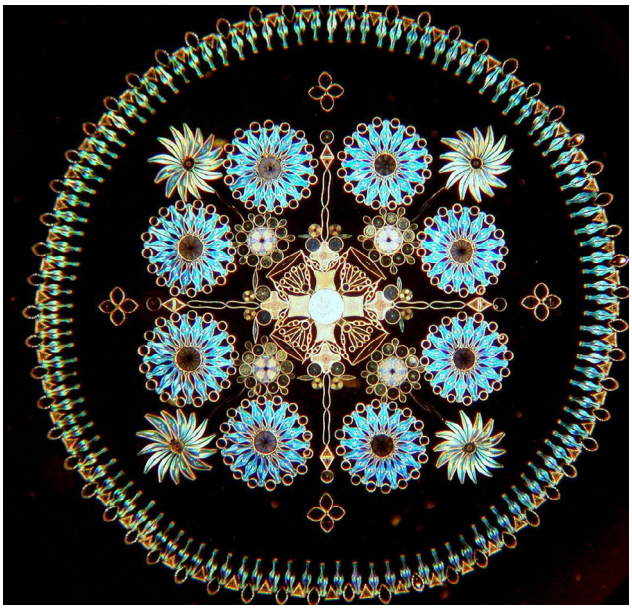
The Victorian period saw a fascination for natural curiosities, which resulted in all sorts of amateur naturalistic practices: shell collections, herbariums, and botanic drawings. Less well known, diatom arrangements nevertheless enjoyed a certain success during the 19th century.

These microscopic unicellular algae with a silica envelope, ranging in size from 5 to 200 microns, have absolutely magnificent geometric shapes. Some artists have undertaken the arrangement of them on microscopic observation plates with the help of a strand of hair, so as to obtain graphic compositions. During the Victorian era, diatom arrangements were bought, exchanged and collected within cabinets of curiosity where they were carefully preserved in small boxes. Those geometric compositions testify to the spirit of the time of ordering the world and the will to represent nature in a rational way.

In 2014, the director Matthew Killip directed the short film «The Diatomist» about the only contemporary practitioner of this long-forgotten art: the British Klaus Kemp has perfected this practice and shows extreme dexterity. He relentlessly samples water points in search of diatoms and has even helped to identify new species. Kemp explains that he is not an artist but simply likes to create regular patterns.

SOURCE

→ **THE DIATOMIST** • BY MATTHEW KILLIP, 2014



CAMARGUE ALGAE COLLECTION

By Adeline Weppe

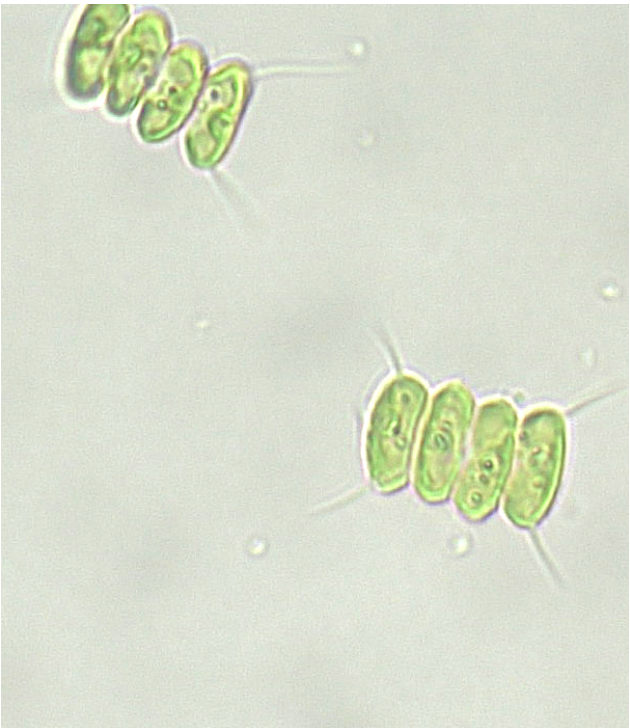
The Algae Platform project began in 2017 with the installation at Atelier Luma of a bio-laboratory for the study of Camargue algae and their enhancement. The Camargue wetland, where the Rhône meets the Mediterranean Sea, has a multitude of different water bodies whose microalgal diversity has been little studied until now. We are striving to map these resources.

The first stage of our work consists of sampling the micro and macroalgae present in the ecosystems that characterise the Camargue: from freshwater to hyperhaline (saline) waters and from natural to artificial water bodies. We therefore cover different systems of channels and irrigation canals, ponds, flooded rice fields, lakes, temporary bodies of water, and saline waters, selecting the water points likely to harbour algae colonies according to the colour of the water and sediment. Water samples which are collected from the surface, the subsurface and the biofilms formed at the water-sediment interface are then concentrated by filtration or centrifugation. Finally, the physico-chemical parameters are recorded in order to serve as a basis for the culture parameters to be applied afterwards in the lab.

Our sampling method is not intended to perform a biodiversity analysis, but nevertheless gives a picture at a given time of the presence of certain species. Out of the fifty or so sampling stations tested, around thirty species or genera were identified. They belong to more than 25 families of organisms distributed amongst archaebacteria, cyanobacteria, ochrophyta (brown algae), rhodophyta (red algae) and chlorophyta (green algae). This gives us an initial glimpse into the diversity of species present to date in the area, however, we are not talking about a species endemic to the Camargue, as most of the species observed so far are widely distributed in similar ecosystems, some of which are even ubiquitous.

We have created an enclosure in which the light and temperature parameters are controlled and are kept constant: conditions necessary to manage the state of the strains. The strains are kept at a low growth rate, both in liquid and solid media, and are transplanted on a monthly basis. Due to the great variability of the natural sampling environments, we use five different nutrient bases for enrichment, each adapted to the salinity of the original natural environment.

Among the strains collected, four now seem to show good potential for biomass production and the majority of the remaining strains, which are difficult to maintain in the growth phase, are kept in a collection in a strain library.



We concentrate our cultivation efforts on strains that either possess a particular pigment (notably absent in higher plants for example) or are capable of mass-producing so-called compounds of interest such as proteins or polysaccharides. Thus, the workshop has an algal culture unit, dedicated to the production of small quantities of biomass that can be used as an adjuvant in materials — notably bioplastics. For this reason, three monospecific cultures of locally collected 'wild' strains — a Camargue spirulina, a Halobacterium and a Scenedesmus are currently being continuously cultivated in the lab.

Today, sampling campaigns continue to enrich the strain library. Although we have not necessarily identified a potential value for all of the strains, the maintenance of the entire library is important both for the creation of a regional collection of species, and for the subsequent identification of new compounds of interest. One objective of the project is to create a material whose matrix and additives (for reinforcement or colouring) come from the different strains collected: a material from the territory and one which would represent the Camargue.

The creation of local biological collections represents precious knowledge for territories in search of their identity and new activities. It would be interesting to see similar initiatives appear in other regions of interest, particularly in river basins and wetlands.

We are curious to hear your ideas and reactions on the issues raised by the Algae Review.
Please send us your ideas, contributions and questions to : algaeplatform@luma-arles.org

ICONOGRAPHY REFERENCES

COVER ALGAE SUMMIT

© Andrea Anner

ARTICLE 1

Image 1
The historical collection of microalgae from the National Museum of Natural History in Paris
©Michelle Dumont

Image 2
The current collection of microalgae and cyanobacteria at the National Museum of Natural History in Paris containing over 1500 strains
© Charlotte Duval

ARTICLE 2

Image 1
Leeuwenhoek's Microscope
TU Delft © all rights reserved

Image 2
Les Invisibles, Théâtre des Menus-Plaisirs, Paris, 1883
© BnF / Gallica

ARTICLE 3

Glass workshop at the University of Lorraine, France
©Université de Lorraine

ARTICLE 4

Microalgae genetically modified so that they show a fluorescent green colour
@ UC San Diego

ARTICLE 5

Image 1
Wooden box containing the Universum Diatomacearum Moellerianum, the most precious diatom arrangement made by J.D. Möller (1844-1907)
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Image 2
Diatom arrangement made by J.D. Möller
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Image 3
Diatom arrangement made by Klaus Kemp
© Klaus Kemp

ALGAE PLATFORM COLUMN

Image 1
Landscape of Camargue, France
@Victor Picon

Image 2
Sampling on the field in the Camargue by Adeline Weppe
© Johanna Weggelaar

Image 3
Sampling on the field and measurement of physico-chemical parameters
© Johanna Weggelaar

Image 4
Culture and analysis of microalgae in Atelier Luma's laboratory
© Victor Picon

Image 5
Culture of microalgae in Atelier Luma's laboratory
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Image 6
Scenedesmus microalgae observed through a microscope
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Image 7
Gyrosigma microalgae observed through a microscope
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Editing : Matilda Sims