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OBJECTIVITY ACCORDING TO LACAZE-DUTHIERS

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EXPERIMENTAL ZOOLOGY
LACAZE-DUTHIERS
EPISTEMOLOGY
BANYULS-SUR-MER
ARAGO LABORATORY
OBJECTIVITY
MECHANIC OBJECTIVITY
EPISTEMIC VIRTUE
POSITIVISM

ABSTRACT. – We celebrated in 2021 the bicentenary of Lacaze-Duthiers. In this paper, we will focus on the epistemology of Lacaze-Duthiers by showing how the relationship to knowledge is part of history, evolves over time and also transforms the relationship to oneself. Thus, we will give an explanation of Lacaze-Duthiers' temperament according to his relationship to science and truth. The positivism that accompanies Lacaze-Duthiers' zoology organizes his way of life down to the details of his own intimacy. Thus, Lacaze-Duthiers is part of the momentum of an objectivist epistemology which seeks to annihilate a subjectivity which is then considered deviant. Finally, we will see that beyond the pure work of zoology, Lacaze-Duthiers worked for the development of a real epistemic network in order to place experimental zoology in a sustainable position. It is therefore between a purist vision of science and networking that the strong personality of Lacaze-Duthiers was forged.

INTRODUCTION

Félix Joseph Henri de Lacaze-Duthiers, an eminent zoologist of the 19th century, is the founder of the oceanological observatories of Roscoff and Banyuls-sur-Mer as well as of the periodical journal entitled *Archives de zoologie expérimentale et générale*, dedicated to the transmission and the presentation of the various works carried out in the respective laboratories. For a work in epistemology Lacaze-Duthiers is interesting for three main reasons.

1. Firstly, he is a pioneer in the study of the environment, that is, he is one of the first naturalists in the world to systematically study living beings in their living environment. Indeed, in the continuity of his master Henri Milne-Edwards, but also Jean-Victor Audouin and Émile Blanchard, he is a precursor of the experimental method applied to zoology, which he named "experimental zoology" (Lacaze-Duthiers 1872). With Lacaze-Duthiers, zoology passes from a simple descriptive and classificatory science to a real biology (Caullery 1950), that is to say a science of the living, and one could even say an ecology in the sense that it is a science of the living which includes the interaction with its environment.

2. Secondly, Lacaze-Duthiers included the life cycle dimension (from egg to adult via embryo and larva), which was also innovative and introducing a new approach to life, notably including a time dimension in experimentation, following living beings in their ontogenetic evolution.

3. Finally, beyond his 256 published works (Pruvot 1902) in the field of zoology, he is a real organizer of this new science by participating in its networking, in particular by providing it with institutions such as the two laboratories he founded (Roscoff and Banyuls) as well as the experimental zoology periodical mentioned earlier.

On the occasion of the bicentenary of the birth of this great zoologist that was Lacaze-Duthiers, I thought it would be interesting to evoke his personality as well as his vision of science. Also, we will see how these two aspects are intimately linked.

WHO IS LACAZE-DUTHIERS? RELATIONSHIP TO THE TRUTH AND TO HIMSELF

Lacaze-Duthiers was born on May 15, 1821 in Montpezat (in Lot-et-Garonne). It will take him only a few years (between 7 and 9 years old) to find his way and become passionate about the animal world. At the same time as he discovered this passion, he formed a vision of science that would never leave him. This is why I decided to start my presentation with a little anecdote that his student Georges Pruvot relates. This anecdote, which depicts the cold and conflicting relationship that little Henri had with his father, will serve as an introduction to what his epistemology will be for the rest of his life. Here is what Pruvot tells us: "One day when his son (Lacaze-Duthiers), already taken with a taste for natural history, was talking to him about winged ants, he impatiently marked his disapproval, and as Henri, proud of his young science, insisted and multiplied the details, he curtly urged him to stop this disrespectful joke. Whereupon the son replied with vivacity that he was silent, but that he did not see how his silence would prevent the ants from flying" [our translation] (Pruvot 1902).

If I chose this little story, it is because it perfectly represents the epistemology of Lacaze-Duthiers, that is to say his theory of knowledge. His early assertion that "silence does not prevent ants from flying" testifies to a widely held view in science in the 19th century that there is an objective reality independent of man; an idea that

is altogether banal today but which really emerged in the 19th century. In order to taunt his father, Lacaze-Duthiers seeks to show him that the outside world is not only complex, but also and above all, that it in no way depends on his own will and that it greatly exceeds his domain of authority.

We therefore perceive very early in Lacaze-Duthiers a desire to deconstruct subjective authority and an orientation towards the external and independent reality of an immutable nature whose laws we should learn. It is therefore a call for a scientific, empirical and inductive approach, that is to say, which consists of collecting a large number of "objective facts" from nature, and then inducing a theory. This inductive approach reveals its greatness in comparative anatomy, which allows, according to Lacaze-Duthiers, to give "proofs that can be placed under the true law" [our translation] (Lacaze-Duthiers 1872). He even speaks of a "real law of a value that might be called cruel, to those who do not see it, *dura lex sed lex* (which literally means: the law is hard, but it is the law); of a law which is not mine, which I accept and which I apply" [our translation] (Lacaze-Duthiers 1872). This is what is commonly called positivism, a school of thought developed in France by Auguste Comte during the 19th century and that advocates a scientific empiricism and an avoidance of metaphysical questions. This philosophical doctrine is opposed to French philosophy, which was still predominantly spiritualist during the 19th century. This is how Lacaze-Duthiers denounces: "… the falsity of the position of a man responsible for speaking about what he does not know and also all the falsity of this so-called science, "a priori", of intuition, of instinct, as the master theoreticians call it" [our translation] (Lacaze-Duthiers 1887). He explains how he saw: "… clearly how insufficient this knowledge acquired in books alone is, especially when this knowledge is drawn from books made by men who, writing theoretically to make books big or small and not seeing nature, go astray and mislead the readers!" [our translation] (Lacaze-Duthiers 1887).

And among these master theoreticians we could speak of Bergson, Ravaisson, Lachelier for the philosophers, but also of certain scientists like Haeckel and even Darwin whom Lacaze-Duthiers considered "too idealistic" (Lacaze-Duthiers 1889), or at least too rocked in theory.

Within zoology, two schools clash around a debate initiated in 1830 between Georges Cuvier and Étienne Geoffroy Saint-Hilaire. To the following question: Why do some animal organs look alike? The two naturalists offer radically different answers. These answers are directly related to their vision of scientific objectivity. Cuvier believed in the inductive method and refused any speculation while Saint-Hilaire formed hypotheses because he believed that ideas, more than facts, were at the origin of great discoveries.

In the first volume of the "Archives of experimental and general zoology", Lacaze-Duthiers names these two schools: "school of facts" and "school of reasoning" [our translation] (Lacaze-Duthiers 1872). He also announces the need for a third school which he claims capable of merging the first two. Indeed, Lacaze-Duthiers "figures practice and theory as representing two living forces, whose union and common action lead to progress, whose opposition produces an entirely opposite effect" [our translation] (Lacaze-Duthiers 1897). Even if the epistemology of Lacaze-Duthiers is nuanced, he has often been represented as a worthy heir to Cuvier's inductivism and it is clear that he was very critical of speculation.

Metaphorically one could present the father of Lacaze-Duthiers as the symbol of a religious and moral authority that positive science would come to surpass. In the field of zoology, for example, invertebrates were mostly considered until the end of the 18th and the beginning of the 19th century as "lower beings", sketches of nature unworthy of study.[1] While later, thanks in particular to the experimental zoology of Lacaze-Duthiers, the study of mollusks will play a primordial role in the development of the natural sciences (Lacaze-Duthiers 1861), and particularly with regard to the theory of evolution (Fischer 2002).

But isn't objectivity another name for the right objective approach? Isn't it the origin of all scientific discoveries throughout history? We touch here on one of the main objectives of contemporary epistemology, namely, to show that the criteria of truth around which a science is based evolve over time. This is what many philosophers and historians of science show, such as Ludwig Fleck, Gaston Bachelard and Michel Foucault, to name a few. Their work consists in showing that the history of science is not only the history of the discovery of reality, but also at the same time the history of the evolution of the criteria of what is true. As M. Foucault said: "Error is not eliminated by the deaf force of a truth that would gradually come out of the shadows, but by the formation of a new way of 'telling the truth' " [our translation] (Foucault 1985). Also, L. Fleck tells us, there is in scientific observation "… a definite disposition for certain observations, but it is first put in place by a certain training, by a certain scientific tradition" [our translation] (Fleck 1935).

And as these criteria of scientificity evolve, they determine the practice of scientists, their beliefs, their desires, their morals, in short, they also determine their personality. We can therefore attempt an explanation of the personality of Lacaze-Duthiers based on his relationship to science and reality.

But what was that personality? The information we have on this subject comes mainly from the testimonies of

[1] Even if certain works were carried out on invertebrates well before the 19th century (Aristotle, Pliny the Elder, Marsigli, etc.), natural theology contributed to distancing the interest in these beings. The 19th century, also called the century of experience, saw a renewed interest in invertebrates, which were conducive to experimentation and also became the central object of research based on Darwin's theory of evolution.

other scientists, testimonies that are often laudatory (and therefore not very objective) but also sometimes through scientific or political conflicts. We also find information in his correspondence and notebooks.

Lacaze-Duthiers is often described as a hard worker, with a tough character, but also very open and non-dogmatic (Pruvot 1902: 37). Lacaze-Duthiers was not a transformist, yet at no time did he attempt to convert his students who were, for the majority, convinced by Darwin's theory or at least by Lamarck's transformism (Lamarckists or neo-Lamarckists as they will be called later). He is also portrayed as someone very generous and very shy, always putting the interests of others before his own.

By exploring his notebooks, we notice an almost total absence of feelings, philosophical reflections and everything that comes down to a thought of subjectivity. On the other hand, he is very methodical, constant, and notes all the possible details, going from his economic expenses to the plans of the buildings of Roscoff and Banyuls. Towards the end of his life, when he began to be seriously ill, he describes his reactions, counts his hours of sleep, the frequency of his cough. He seems to take himself as an object of scientific study, never revealing anything about what he feels intimately.

Of course, it would be exaggerated and even dishonest to reveal the character of Lacaze-Duthiers only through his laboratory practices. Despite a life devoted to science, he was nonetheless a sentimentalist. His diary, his correspondence, the organization of his house in Las Fons, or even the drawings of Catalan women he made during his first trip to the Spanish coast (Lacaze-Duthiers 1879-1899) are precious witnesses to this. He was also engaged in a family life that he had adopted, that of Lanceplaine, his wife and their children, whom he considered his own, whom he raised as his own and to whom he bequeathed his fortune. On the other hand, he also sometimes reveals the sadness of his loneliness and this unfulfilled desire for human sharing. This is what we see in this melancholy sentence: "Can the happiness I feel in studying nature ever be dull?… I have sometimes found myself alone, quite alone, in Saint-Jacut…" [our translation] (Pruvot 1902)[2].

Finally, what is truly interesting is not to determine whether Lacaze-Duthiers was a sentimentalist or an objectivist machine, but to show how he embodies an epistemological break, specific to the 19th century, which consists precisely in separating subjectivity from objectivity into two distinct worlds. This separation is historically constituted and does not hold a transcendent and eternal epistemic value. This new organization of knowledge and subjectivity is both the product of scientific actors and the environment that determines their ways of acting. On the other hand, this goal remains an ideal in the sense that it is impossible to clearly determine what is subjective and what is objective. This is why it becomes interesting to analyze the interpenetration of these two polarities, associated with the contradictory desire for a total epistemological separation. However, I think that in the case of a scientist such as Lacaze-Duthiers, objectivist polarity takes precedence over subjectivity. This does not mean that the first causally determines the second, but that it strongly orients and influences it.

EPISTEMOLOGICAL APPROACH TO UNDERSTANDING LACAZE-DUTHIERS

After having presented in outline his particular character, we can propose an explanation of his temperament from an epistemological approach. Concerning the objectivity of Lacaze-Duthiers, we will see that this vision of science is specific to the 19th century, particularly in the field of zoology. And to do this, we will use the work of two contemporary historians of science: Lorraine Daston & Peter Galison. These two authors have a historical vision of the criteria of truth: they show that science evolves over time and that it always orients itself from what they call "epistemic virtues"[3] (Daston & Galison 2012). These are therefore virtues that are supposed to lead to knowledge, to orient us towards the truth. For example, Lacaze-Duthiers' objectivity is held by virtues such as patience, erudition, neutrality, methodical work, the refusal to pose abstract hypotheses, etc.

Lacaze-Duthiers, for example, used to say that "doing little, but doing well, is already doing a lot" [our translation] (Lacaze-Duthiers 1861) and his former student Louis Liard (who became Director of Higher Education at the Ministry of Public Instruction) spoke of him by referring to "this great worker of science" [our translation] (Liard 1902). Finally, this notion of objectivity is also found in his temperament and his desire to orient himself towards the outside world, even if it means restraining his feelings, in the name of objective science.

However, these virtues have not always been the same throughout history, and they will probably not be the same in the future. To prove this, it is enough to go back to the century which precedes Lacaze-Duthiers. Daston & Galison show how 18th century scholars did not seek objectivity in the sense understood by Lacaze-Duthiers. Yet this does not mean that they do not seek the truth, or even that these scholars were mediocre; they just had other criteria, other epistemic virtues.

[2] This quote is taken from the personal diary of Lacaze-Duthiers, which has since disappeared. G. Pruvot revealed part of it in 1902 in volume 1 of the archives of experimental and general zoology.

[3] Epistemic is a somewhat scholarly word that simply designates what relates to knowledge or science: we could very well say "virtues of knowledge" or "scientific virtues".

TRUTH FROM NATURE

The scholars of the Enlightenment and the beginning of the 19th century (thus before Lacaze-Duthiers) praised the regularity of divine law, this is what was called natural theology (Andler & Saint-Sernin 2002). It was a science of principles rather than exceptions of nature. Linnaeus, the great naturalist of this century (along with Buffon) called certain varieties of plants grown by gardeners and florists "monstrous", therefore deeming them unworthy of scientific study. Art was therefore not necessarily separated from science, as we have become accustomed to doing today, since beauty, order, were closely intertwined in judgments of truth.

It was of course nature that acted as a model (for art as well as for science), but it was an improved nature, selected, synthesized. In atlases and bestiaries, the animals represented were not real animals, but always the prototype of an animal supposed to represent the essence of its species. Goethe, for example, speaks of the Urpflanze (Goethe 1787) to express the generic model that nature sets itself the task of following in order to give a certain flower or a certain ideal plant. But we could also cite Albinus who did not hesitate to propose in his anatomy atlases images of objects he had never seen (Albinus 1747).

It is therefore not the objective detail that we seek to represent in the 18th century, but the traits that characterize an essence. The mediation of the scientist was therefore necessary to detect these characteristics, and the experience acquired by the naturalist during his career gave him the ability to see the typical in the midst of diversity; it was the culmination of a lifetime. To put it another way, we were looking for "the idea in the observation, not the raw observation" (Daston & Galison 2012: 90). According to the scholars of the 17th and 18th centuries, nature is full of diversity, but science cannot be. They then follow another epistemic virtue than objectivity, which Daston and Galison call "truth from nature" (Daston & Galison 2012). "For naturalists aspiring to truth from nature, a true image was certainly not one that accurately described what was seen. Rather, it was a reasoned image, the result of a juxtaposition of reason with sensation and imagination, and a juxtaposition of the will of the naturalist with the eyes and hands of the artist" (Daston & Galison 2012: 119)

THE ETERNAL OBJECTIVES – MECHANICAL OBJECTIVITY AS AN EPISTEMIC VIRTUE

But at the turn of the 19th century, we began to understand that subjectivity was biased, insufficient, non-exhaustive and filled with prejudice. There are undoubtedly many reasons that converge but it is important to note the proliferation of newly discovered animal and plant species, especially during maritime expeditions around the world; indeed, the immense diversity that is revealed seems to make it impossible to put nature into an equation. The complexity and diversity of living things make any desire for an ideal systematization of nature obsolete and therefore call for humility and the study of detail. The subjectivity of the scientist is therefore overwhelmed by an overflow of information that is nevertheless necessary to describe and classify. The scientist then seeks to distance himself as much as possible from this subjectivity in order to describe reality in a neutral and "objective" way. It is color that becomes, in the second half of the 19th century, the typical example of private and incommunicable subjectivity. An anecdote will help to understand the awareness of the fragility of subjectivity.

In 1876 a railway disaster took place in Sweden. This disaster is attributed to the color blindness of a railway employee who misinterpreted a signal. Following this accident, the railway company had its employees tested, and it turned out that of the 266 employees who were tested, 19 were found to be color blind! The subject therefore becomes dangerous and leads away from the true nature of things; it is therefore now a matter of curbing this subjectivity.

It is clear that the concept of objectivity is then a concept of negation of the subject by itself. As Daston & Galison say, "By an algebraic process, the subject's negation of subjectivity became objectivity" (Daston & Galison 2012: 238). Arthur Schopenhauer, 19th century German philosopher, will say that it is a "will of non-will" (Schopenhauer 1819), that is to say a subjective desire to eradicate the subject in favor of the unveiling of the reality of the world. This desire for objectivity will be put forward by the scientists who are called "positivists" and will be severely criticized by certain poets and philosophers. I quoted Schopenhauer just now, but we could also talk about Nietzsche who evokes, not without irony, those scholars who try to eradicate subjectivity. He calls them, I quote, "this race of eunuchs… neither man nor even woman, nor even hermaphrodite, but always and only neuters or, to speak more cultured, the eternally objective" (Nietzsche 1874).

Schopenhauer and Nietzsche see in this objectivity a sick will, capable of turning against itself. This self-harm, which seeks passivity and neutrality, then entails moral imperatives which "evolve accordingly to fight the temptations first of imagination, then of subjectivity." [our translation] (Daston & Galison 2012). We thus go from a desire to interpret well, to a desire not to interpret at all! It thus established itself in the 19th century: "a new model of epistemological conviction, image-making and moral behavior which aimed to silence the observer and let nature speak" (Daston & Galison 2012: 143).

"Scientific objectivity, understood as a new epistemic value, was therefore an imperious desire to suppress any voluntary intervention by the scientist by implementing methods capable of imprinting nature on the page by

following a strict, even automatic protocol" (Daston & Galison 2012: 144). This is called, to play with the paradox, "blind vision". This new epistemic virtue is called by Daston & Galison "Mechanical Objectivity" (Daston & Galison 2012). The term "Mechanics" is added to that of objectivity because machines replace the will of the researcher, they become a guarantee of scientificity, they are neutral, tireless, devoid of prejudice, unlike the human subject. Charles Babbage (mathematician and philosopher, precursor of computing) said that: "one of the great advantages of the machine is to serve as a safeguard against the inattention, negligence or laziness of man" (Babbage 1822).

It is photography that very quickly becomes the emblem of this new scientific virtue since it was supposed to represent nature as it is, without human intervention; neither by his hand nor by his ideas. Scientific photography was seen as a way of depicting nature, bypassing art and therefore subjectivity; it was a new symbol of authenticity, "safe from the inner desire to theorize." (Daston & Galison 2012: 165).

I would like to warn here of a possible misinterpretation of what has just been said. It could be objected that photography took a long time to establish itself in the scientific field as an effective technique. Indeed, Lacaze-Duthiers did not develop his experimental method through the technical invention of photography; he also used drawing throughout his life. What I want to show is precisely that photography is not only considered as a technique but also as an epistemic ideal specific to the second half of the 19th century. Considering technical evolution as the only explanation of scientific progress is an interesting theory but remains a theory. In this article, I want to show that technique and epistemic virtues co-determine each other and that there is no need to designate one of them as a cause, and therefore the other as a consequence.

Indeed, if photography has become the fundamental metaphor of objective truth (Daston & Galison 2012: 219), it is not because it is more faithful or better represents this nature. "If it is indeed, in this respect, a visual revolution, the pictures do not replace the illustration" [our translation] (Glansdorff 2012). Indeed, for a long time drawing, engraving or lithography were much more precise and much more faithful methods than photography. Even after some technical advances, "the accuracy of the photograph does not allow, as does the illustration, the construction of archetypes, representation paradigmatics whose abstraction fits better with scientific discourse" [our translation] (Glansdorff 2012). So it's not for that reason, but primarily because the camera seemed to do without human activity. It had become the emblem of a non-interventionist science, and thus of an erasure of the subject in favor of what the 19th century philosopher Thomas Nagel called the "point of view from nowhere" (Nagel 1986). The nineteenth-century scholar sought to discipline his "inner enemies" (Goethe 1792), by principles of method, measure, and work.

However, this vision of science, seeking objectivity, in turn influences what Daston & Galison call "the scientific Self" (Daston & Galison 2012), that is to say the "character" that the scientist creates for himself in reaction to his relationship to reality as well as to the methodology he puts in place to apprehend it. Indeed, if there are virtues to follow, there are methods, techniques, ways of doing things, which the scientist of the 19th century imposes on himself and therefore which builds his identity.

Now, it turns out that Lacaze-Duthiers meets these criteria of mechanical objectivity perfectly. We can therefore understand his personality from the prism of epistemology. Being a great scholar, guided by a particular vision of science and a certain relationship to truth, he necessarily had to build his identity around these questions.

By taking up the work of Michel Foucault, Daston & Galison start from the principle that these practices, in which Lacaze-Duthiers takes a large part (such as the keeping of lab notebooks with daily note-taking, the drawing of specimens, the regular monitoring of one's beliefs and assumptions, control of the will and channeling of attention), are not only the expression of a self, but that they shape and constitute it. "Embracing objectivity – or one of its alternatives – was not just about practicing a science, it was also giving shape to a self" (Daston & Galison 2012: 16). And the self is reinforced by specific techniques.

Mechanical objectivity imposed restraint, a will strong enough to restrain itself, and perseverance and patience were among those virtues that zoologists like Lacaze-Duthiers were particularly fond of. We then move from a vision of the scientist as an "abstract genius" to a vision of the scientist as a "hard worker". Personalities may change, genius and brilliance seduce, what ultimately mattered was heroic self-mastery, the watchfulness of a willful self that could contain the genius overflows of the imagination and, coupled with that, a mixture of assiduity and precision. The physiologist and physicist H. Helmholtz (1821-1894) confessed that the ideas his admirers took for sudden enlightenments came to him "little by little, after months and years of hard and often trial and error, from insignificant germs" (Helmoltz 1966). But it is also obvious in Ch. Darwin (1809-1882), contemporary of Lacaze-Duthiers, who admitted in his autobiography that he did not have "that remarkable speed of understanding that certain intelligent men have". "All my work," he said, "has been to observe and gather facts." (Darwin 1887).

This same "style of thinking" (Hacking 1992) is also often found in Lacaze-Duthiers. Objectivity is therefore not the name of reality, but a knowledge program that determines at a specific time how scientists must proceed to obtain knowledge. This "epistemic virtue" thus entails

particular practices, particular psychologies, particular lives, always in relation to this epistemology.

What is interesting through this study is not so much to know which of these virtues is the truest or the fairest, but rather to analyze the way in which these ideals act on the organization of science and on the scientists themselves. Pure objectivity is an effectively impossible quest (and no scientist claims to achieve it completely) since knowledge necessarily emanates from the subject or the collective and it is always inscribed in a specific environment and in a particular era.

But "that a rule of the game is imperfect does not prevent it from determining the way of play of the participants" [our translation] (Daston & Galison 2012). And this is why Daston & Galison speak of a "regulating ideal": "Goethe never succeeded in isolating the archetypes of nature, any more than Jaeger in turning himself into a machine, but the very act of striving for truth from nature or mechanical objectivity can change science and the self, even if, like all virtues, these epistemic virtues are made never to be fully realized" [our translation] (Daston & Galison 2012: 272).

Objectivity is therefore not the truth, it is a regulating ideal that defines the path to be taken to reach the truth. In the case of Lacaze-Duthiers, we note for example an activity of taking regular notes, an obvious restraint of all questions of a metaphysical, religious or philosophical order, an almost ascetic practice of the description of phenomena, of detail, and above all the rejection of grand theories.

PERSONALITY AND EPISTEMOLOGY WITH LACAZE-DUTHIERS

The evolution of science can't be without an evolution of the personality of scientists. The act of knowledge always involves a transformation of the one who undertakes to know. Lacaze-Duthiers transforms the practice of zoology, and in turn, this practice transforms the identity of Lacaze-Duthiers. By seeking at all costs objectivity, the pure description of nature, without human intervention, Lacaze-Duthiers constitutes both a science and at the same time shapes his identity.

His character has often been attributed to his Gascon origins, to his childhood spent between a self-effacing mother and an authoritarian father, living in precariousness (Petit 1968). So many criteria explaining the calculating, cold, reserved, shy temperament that will follow him throughout his life (Petit 1968). This is the interpretation of Georges Petit, former director of the Arago laboratory who was interested in the history of science. I quote him: "In the middle of lands and woods, in the sad home of Stiguederne, in contact with a father who was certainly more than authoritarian, with a well-removed mother, Lacaze-Duthiers' childhood was marked by severity, bringing frequent clashes for him, creating repressions and complexes. This childhood weighed on his whole life. Thus, his entrepreneurial spirit, which he inherited from his Gascon origin and which is one of the traits of his character, was tempered with shyness and mistrust. This mistrust led him to be timorous" [our translation] (Petit 1968).

Georges Pruvot also reveals this impersonal temperament: "Distrustful more of himself than of others […] He stiffened in a somewhat fierce moral solitude. But if passion sometimes led him beyond the bounds of strict defensiveness, and perhaps even of impartial equity towards persons, it was always the disinterested passion for science and the public good; no personal interest ever moved him. He always remained very simple, of an absolute disinterestedness, and basically very good" [our translation] (Pruvot 1902: 30).

Instead of psychoanalytic explanations, we can substitute an epistemological explanation, that is to say, as I have shown, an explanation based on the relationship that Lacaze-Duthiers maintained with science and reality. Finally, "mechanical objectivity" makes it possible to understand in large part this very particular character. At age 78, Lacaze-Duthiers' health deteriorated. In 1899, he left for a cure at Néris-les-Bains, as he had been doing for several years[4]. Georges Petit notes that "This time, he analyzes himself hour by hour" (Petit 1968). Here is an excerpt from his notebook of 1891: "At 10 a.m. I smoke Datura, go to bed. Sleep at 11:30 a.m.; awakening and asthma. I smoke a cigarette (from Datura), burn some paper and get up. I'm falling asleep. But sudden awakenings. At 1:30 a.m. I eat, at 2 a.m. I go to bed and sleep until 4:30 a.m.; at this moment I am forced to get up. The edema of the flat of the thighs continues." [our translation] (Lacaze-Duthiers 1879-1899).

By noting all the smallest details of his life, of his health, Lacaze-Duthiers becomes a recording machine, just like the camera; which brings us back perfectly to the virtue of mechanical objectivity.

Of course, Lacaze-Duthiers did not become a machine, strictly speaking, and he had an intense social life on a human level. Testify to this, his many dinners (with the painter Cermak, his colleague De Quatrefages, his friend Potain, his cousin Drême and many others), his many friendships (Pierre Lanceplaine and his family, the mechanic David in Banyuls, childhood friends from the college in Villeneuve-sur-Lot and many others) but also his affection for his mother and his sister Elizabeth. We can also evoke certain emotional conflicts such as the one with his father or with Alfred Giard. Lacaze-Duthiers

[4] This is not the first time that Lacaze-Duthiers has traveled to Néris-les-Bains for his health, he has been going there regularly since the early 1870s. From 1860, around the age of forty, he began to worry about his state of health and began spa treatments. It would seem that he was, if not a hypochondriac, at least very attentive to his health.

remained a human being and my remarks do not question this point. However, it is a question of showing that a certain scientific practice, organized around a particular epistemic virtue, partly influences the subjectivity of its author. The simple fact of clearly wanting to separate between objective scientific activity and social life (or scientific identity and personal identity) testifies to this particular orientation which shapes practices and personalities. It is not about questioning the validity of an epistemology (or of an epistemic virtue), but of examining what it prohibits and what it authorizes in order to understand the constitution of objects and subjects. So, in a certain sense, if, as Georges Petit points out, "Lacaze appears in the notebooks where he traced the little story of his life, like a man without enthusiasm" (Petit 1968), we can now interpret it as the logical unfolding of the evolution of a 19th century zoologist who devoted his life to the virtue of mechanical objectivity; that is to say, to the scientific virtue of his time.

EPISTEMOLOGY IN ACTION

There is therefore a close link between the epistemology of Lacaze-Duthiers and his personality, both of which merged in a great tension. Lacaze-Duthiers has not succeeded in respecting this positivist epistemology in detail (Brière *et al*. 2018). He did not know how to always remain neutral and objective, he did not succeed in keeping science and society, nature and culture entirely separate. One could even say that he has worked much of his life to do the exact opposite. But it is precisely this contradiction that makes Lacaze-Duthiers one of the great pillars of life sciences today. But what contradiction exactly?

Well, there are two major contradictions or tensions that are at work in Lacaze-Duthiers: on the one hand between the desire for passivity and the appearance of experimental practice, and on the other hand between the desire to aim for pure science, disinterested, and the growing socialization of experimental zoology. Daston & Galison tell us that the personality of the mid-nineteenth century scientist "was dominated, in almost every facet, by this tension between humble passivity and active intervention with nature" (Daston & Galison 2012: 252).

It must be understood that this tension is not a dead end for scientific development and that the two contradictions mentioned reveal an effectiveness constituted at the very heart of the conflict between an objectivist epistemology, positing a reality external to the subject, and an experimental and socializing practice which consists on the contrary in integrating the subject into its object of study. There is therefore an epistemological contradiction, or more precisely a conflict between an epistemology and a practice.

If we stick only to the scientific or epistemological writings of Lacaze-Duthiers, we see a perfect coherence that brings us back to mechanical objectivity and a purist vision of science; that is to say bearing on an external world, which has nothing to do with politics, economics, ideology, etc. and whose scientific practice consists precisely in separating oneself from the obstacles imposed by subjectivity.

But if we go further than the neat texts, and even further than the texts as such, and if we look at the activity, the practice of Lacaze-Duthiers, we see that he spent a large part of his life to meet politicians, to seek investors, to communicate, to teach, to popularize, to travel and finally to build observatories. At last, it seems that his "will to non-will" was outbid by a desire to network experimental zoology. And given Lacaze-Duthiers' temperament, previously explained by his vision of science, this socialization of zoology, its networking, was experienced by him as a real sacrifice!

Indeed, we understand very well that for a follower of the pure science, it was so difficult to shake hands with politicians and entrepreneurs. Yet that is what he did and what he was right to do. Because it is thanks to this that his legacy spreads today to a wide audience and not only to the few scientists who are part of the continuity of his field of expertise.

It is partly for this reason that Lacaze-Duthiers marks the history of zoology. He understood that science is above all an organization and that it needs structures. He also understood that the discovery of reality is directly proportional to the enlargement of this network. And it is not only made up of objective scientists describing reality, it also includes engineers, divers, archivists, historians, philosophers, popularizers. But also accommodations, canteens, tools, buildings, ships, microscopes, aquariums, a set of human and non-human entities that form a network; a network that could be called epistemic, and which in our specific case concerns experimental zoology.

Lacaze-Duthiers' work makes it possible to go beyond mechanical objectivity, since he bequeaths not only scientific knowledge, and even less a great theory, but real concrete means for doing science. His work continues to prove that zoology depends on a network that is becoming denser; and this is made up of all these entities that I have just named and which in some way form the structure of experimental zoology, a structure from which one cannot remove a part, without at the same time removing a part of its reality.

The great strength of Lacaze-Duthiers is therefore to have set up a network and provided the means to do science. And these means, tools, and technical sets, of which we can take the Arago laboratory – but also the Roscoff laboratory – as an example, last over time, and bring together a considerable number of people; ranging from scientists to tourists who visit the aquarium, passing by some curious who come to attend conferences. It is clear

that the construction of a center brings together many more people than writing a thesis on red coral (or a thesis on the reproductive system of insects) (Lacaze-Duthiers 1853).

If Lacaze-Duthiers had stuck to his area of expertise, it is very likely that the publication of this article would never have taken place and that the bicentenary of his birth would have brought together far fewer people. The very fact of this event testifies to the organization of a network which was made possible by Lacaze-Duthiers and which continues to expand. It is that Lacaze-Duthiers understood that zoology is not only the result of a desire to know nature, but above all depends on its ability to connect to the social and technical world; that is to say, to make links and associations, to create collectives.

Today, we understand that this vision of a nature independent of man is beginning to "battre de l'aile" (French expression to say being in a bad state), simply because we understand how much human activity has an impact on this nature.[5] And we could say finally, that the great epistemological evolution of our time, compared to that of Lacaze-Duthiers, is to understand that silence, evoked by this child of the 19th century nature enthusiast, is finally able to prevent ants to fly. I mean by this, not on a moralizing but purely epistemological level, that we understand today that there is something social in what we call natural, and conversely that there is nature in what we until then considered to be independent of the world, like the soul, the spirit, the reason, science, man, etc. In other words, the border that separated man from nature, subject from object, art from science, what is commonly called a dualistic philosophy becomes more and more problematic (Putnam 2004). Postmodern man learns that his silence or his uncontrolled action can indeed prevent ants from flying. A thought that Lacaze-Duthiers obviously could not have 150 years ago and that we must welcome today.

So certainly, Lacaze-Duthiers was guided by a philosophy of science specific to his time which largely separated nature and culture. But what makes him a central point in the evolution of zoology is the fact of having provided the means to go beyond this philosophy of science. By building the two oceanological observatories of Roscoff then Banyuls-sur-Mer, by bringing together researchers, but also students, by working tirelessly to provide tools, experimentation, but also the transmission of knowledge, Lacaze-Duthiers built experimental zoology, he structured it, gave it form and substance. This allows his successors both to inherit his knowledge, his epistemology, but also and above all the practical means that he put in place during his life, making it possible to continue this heritage by going beyond it while paying homage to him.

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[5] Of course, this positivist vision of a science applied to an external nature was criticized at the end of the 19th century and most 20th century naturalists did not adhere to this epistemological belief. However, I think this thought has remained present as an epistemic ideal. The novelty is not in the denunciation of a fantasized objectivity (which scientists do), but in the questioning of the very notion of objectivity, understood as an external reality for which science must account.

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