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AN INTERVIEW WITH YVES CHEVALLARD ON THE ANTHROPOLOGICAL THEORY OF DIDACTICS

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Yves Chevallard is a French professor and researcher in Didactics of Mathematics, considered one of the main exponents of this area, along with Guy Brousseau, Gérard Vergnaud, Michèle Artigue, among others. An ex-student of the *École Normale Supérieure* after passing the aggregation exam in 1970, he became a math teacher in his former school. He worked at the Institut de *Recherche sur l'enseignement des mathémaques d'Aix-Marseille* (IREM) being responsible for the formation of student teachers. In 1976, he met Guy Brousseau at the IREM in Bordeaux and, from then on, he was strongly influenced by his work on the theory of didactical situations thus he started his path in the Didactics of Mathematics. He is currently emeritus professor at the University of Aix-Marseille.

In the 1980s, Yves Chevallard became known for his theoretical contributions to the Didactics of Mathematics, particularly for his theory of didactic transposition, which makes it possible to study the relations between the different forms of knowledge and the transformations undergone by the scholarly knowledge in various institutions until it becomes taught knowledge and learned knowledge. For Chevallard, knowledge is the result of human production and, therefore, its use and its operation depend on the institution in which it lives, that is, knowledge does not exist in a vacuum. Continuing the study of the phenomena of didactic transposition, in the early 1990s, Chevallard developed the Anthropological Theory of Didactics (ATD), for which didactics is present every time an individual *y* does something so that other individual(s) *x* learns a certain object of knowledge, which characterizes a didactic system. ATD considers that any human action can be defined within the scope of praxeology, which is composed of the Praxis block, consisting of techniques that enable the realization of types of tasks, and the Logos block composed of technology (function of production and

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justification of techniques), which in turn must be justified and explained by a theory, thus constituting the praxeological quartet (task, technique, technology, theory).

ATD is now known in many countries, and has its own event, the International Conference on the Anthropological Theory of the Didactics (CITAD), which held its 7th edition in 2022. This conference is aimed at bringing together researchers who develop studies and research on ATD and in its editions has received, increasingly, researchers from various parts of the world. Finally, it is important to highlight the great contribution of Yves Chevallard to Mathematics Education with the production of books, articles of various kinds, and participation in international conferences, a contribution that was recognized by the International Commission on Mathematics Education, which awarded him, in 2009, the Hans-Freudenthal Medal. The reader can read a more detailed summary of his trajectory in the link: https://ardm.eu/qui-sommes-nous-who-are-we-quienes-somos/yves-chevallard/ and can also consult a list of some of his published texts, arranged in chronological order, in the link: http://yves.chevallard.free.fr/spip/spip/.

Marilena Bittar and José Luiz Magalhães de Freitas: On behalf of the Revista Paranaense de Educação Matemática - RPEM, we would like to thank you for accepting this interview. We are convinced that it will make an important contribution to the reflections, studies and research in didactics of mathematics in Brazil, especially with regard to the anthropological theory of the didactic.

You started working at the IREM in 1972, you met Guy Brousseau in 1976 and with Claude Comiti you organised the first summer school in the didactics of mathematics, held in 1980 in Chamrousse. Could you tell us a little about your experience during this period, which could be classified, perhaps, as the decade of the emergence of the didactics of mathematics in France?

Yves Chevallard: I can only answer, of course, in a subjective way and according to my memories. When I started working at the IREM, at the beginning of the calendar year 1972 (in February, I think), I had just been recruited a few months earlier as an assistant by the mathematics department of what was then the University of Aix-Marseille II. Why was I at the IREM as an "animator"? At that time, I was unaware of the very existence of didactics. (I'll come back to this.) This is a time when, because of the reform of "modern mathematics" (New Math), there was a concern to “recycle” teachers—such was the unvarnished vocabulary of the time: the IREM was "recycling" teachers. So, for me and a few others, it was a question of introducing practising teachers to certain mathematical notions and theories that they had never encountered in their studies and that they must thenceforth teach or, at least, not ignore. This was the case, in particular, for probabilities or the notion of "affine line" in Grade 8, of which I find the following presentation on the Internet (https://www.mathematex.fr/viewtopic.php?t=15927):

> By definition an affine line D is a set E with a family ϕ of bijections from E into $\mathbb{R}$ such that
> a) For any f element of ϕ, and for any element (a, b) of $\mathbb{R}^* \times \mathbb{R}$, the application defined by $g(M) = af(M) + b$ also belongs to ϕ.
> b) Conversely if f_1 and f_2 are any two elements of ϕ, there exists (a, b) belonging to $\mathbb{R}^* \times \mathbb{R}$ such that $f_2(M) = af_1(M) + b$.
> The set E is called the support of the line D, an element M of E is called a point of the affine line D.
>
> Comments on the 8th grade curriculum (December 1971).

Of course, this exploration of mathematical notions new to these teachers did not exclude certain "pedagogical" considerations we would call today "didactic". Moreover, at the IREM, I worked with some colleagues in a "workshop" (i.e. a working group) that I had created and entitled Atelier "*Mathématiques et interdisciplinarité*" (AMI) i.e. Workshop "Mathematics and interdisciplinarity": the general idea was to enrich the cognitive universe of teachers by diversifying it. This will lead in particular to the publication, in 1977, by the publisher CEDIC (Paris), of a booklet of about one hundred pages entitled "Two mathematical studies on parenthood" – one of these studies had to do with population genetics, the other with the anthropology of Claude Lévi-Strauss (1908–2009). But, at that time, my encounter with the didactics of mathematics had already taken place.

In June 1976, Guy Brousseau was invited to the IREM of Aix-Marseille to create, at the request of the colleagues of the IREM who were in charge of this project, a preparation centre for the post-graduate diploma in didactics of mathematics which existed at the University of Bordeaux I. I was invited to the inaugural meeting, which will be decisive for me. But I was only there in a very modest capacity: as a teacher in the mathematics department, I had been asked to welcome future postgraduate students to the working sessions with my students so that they can make "didactic" observations. It was on that day in June 1976 that I discovered Guy Brousseau and the didactics of mathematics: I just turned thirty (I was born on a 1st of May). In truth, I didn't understand much of what Guy, who is inexhaustible, told us over several hours of exchanges. But I told myself that his volubility was the sure symptom that something existed, that I did not know (yet), and that he called didactics. This was the absolute starting point of my commitment to didactics. Things were to go very quickly. For several years, Guy Brousseau (and other colleagues from Bordeaux, such as Michel Brossard) came regularly to the IREM of Aix-Marseille to give lectures, which I followed passionately, but in the unofficial capacity of a simple "honourable correspondent". At the same time, I regularly visited the IREM in Bordeaux and the Jules-Michelet school in Talence. In Marseille, the first DEA "students", who were in fact colleagues teaching mathematics in secondary schools, emerged – in this respect, I am pleased to pay tribute to Odile Schneider and Jacques Tonnelle. (The DEA is what corresponds to today's Master 2: see https://en.wikipedia.org/wiki/Master_of_Advanced_Studies). It was in those years that what would soon become the "theory of didactic transposition" (to which I will return) was constructed, in particular in the context of the work done by the two colleagues just mentioned, whom I supervised, a "theory" which I was to explain in a course given at the first summer school on the didactics of mathematics, in July 1980.

What can I say about this pioneering period? On reflection, two features stand out for me. Of course, we worked a lot; we worked without counting the hours. But this is a fact that must be placed in a context that has since withered away: throughout the 1970s there was a collective enthusiasm, a social energy that led many of us to embark on new projects aimed at reshaping the old society denounced by May 68 (see https://en.wikipedia.org/wiki/May_68). In our field, the big shake-up was the "New math reform", which mobilised energies (see https://en.wikipedia.org/wiki/New_Math) and led to the creation of the IREMs. Of this collective energy, I will give here only one apparently "minor" example. At the instigation of younger colleagues, who had been trained in so called "modern mathematics", a group of secondary school teachers met to study the 1965 book by Jean Dieudonné (1906–1992), entitled "Fondements de l'analyse moderne", a translation of a book published in English in 1960 (from a course given by the author in 1956-1957 at an American university), Foundations of Modern Analysis (see https://fr.wikipedia.org/wiki/Référence:Analyse_(Dieudonné_Tome_I)). To judge the effort undertaken by this humble group, one can refer to the Wikipedia article which gives the summary of the work (at https://fr.wikipedia.org/wiki/Éléments_d'analyse) or to the original work in English (for example at https://bit.ly/3K7GxJ7). This was the "state of mind" of the time – which would last, I believe, until the early 1980s.

What did we want to do with this available collective energy? This is a second point, which I would like to stress perhaps even more than the previous one. We should not indulge in a terrible anachronism here. The efforts we were making were not simply aimed at getting young students to obtain a Master's degree, and later a doctorate in didactics of mathematics, while their teachers were publishing in scientific journals! This familiar pattern should be read in the reverse order. Everything we did had a fundamental aim: to create a science, through scientific productions that were often not yet "publications". This science, whose possible existence Guy Brousseau revealed to us, was still in limbo. The theory of didactic situations, which was already well-developed, developed a little more each day. As everyone knows, there were first the "dialectics" of action, formulation and validation. One day, as we arrived, two other people and myself, at the Jules-Michelet school, we were greeted by Guy Brousseau who exclaimed without further ado: “There is a fourth dialectic!” The dialectic of institutionalisation had just been born. Creating a science, which Guy had taught us was neither pedagogy nor any of the existing sciences, such as psychology or sociology, was our first and last goal. In my view, even a DEA thesis should contribute to this creation. Conversely, the academic "profitability" of our work was not our primary concern. This explains why I was able to write, in the summer of 1981, a text of more than 160 pages – entitled “*Pour la didactique*”, without ever thinking of publishing it in due form. This freedom from the requirements of the standard scientific world seemed to me (and still does) necessary for the creative effort we had to make. A colleague and friend, a professor of physics at his university, who looked sympathetically at the work we were doing, once made this grim collective prognosis: “Unfortunately, you will never become [full] professors.” The didactics of mathematics was not then a recognised specialty worthy of all the resources granted to a “genuine” university specialty. We know today that he was wrong.

We would like you to tell us a little about the beginning of your studies and research in the didactics of mathematics, especially on didactic transposition and the anthropological theory of the didactic.

Yves Chevallard: The science to be created was what I have since called the science of the didactic. During these first years, with those who accompanied me (and most of whom will accompany me for a long time), we worked mainly on teaching up to Grade 10, in particular with regard to algebra, but not only. I will not go into this detail here in order to consider only the emergence of the theory of didactic transposition, of which I have already said that I was to give an extensive presentation in July 1980, within the framework of the first summer school in the didactics of mathematics – it is this presentation which, essentially, will be published in 1985 by the publisher “*La Pensée Sauvage*” in Grenoble.

To explain the development of the idea of didactic transposition, we need to start from an ever-recurring phenomenon: anything taught over a fairly long period of time – say, a few decades at least – tends to be perceived by those who teach it as taken for granted, as "natural". Multiplication is what is taught under this name (which means: in such and such type of institutions). And the same goes for the notions of number, factoring, limit, etc. (The list would be endless). So you have multiplication, division, factoring, etc. This is the usual state of institutional and personal relations to the objects to be taught during what I call a curricular stasis, which can last a long time! If this naturalistic illusion did not exist, there would be endless dialogues such as: “So you do have to teach multiplication”. “But what exactly do you call multiplication?” “Well, what you know...” In fact, throughout a curricular stasis, teachers can be recognized by the fact that they "know" what "multiplication", "division", "factoring", etc., are, even if they think they know them poorly. In the institutional world in which they are immersed, there is, if I may say so, existence and uniqueness of these objects: this goes without saying. This is the starting point.

The period I am talking about, however, is one in which the old curriculum was abruptly and brutally disrupted. Did you think you knew what a line was? Then suddenly the notion of an affine line comes along. And suddenly you feel like you don’t know anything. When the praxeological changes are discrete, isolated and infrequent, this is still acceptable. But the massive changes brought about by the New Math reform were a game changer! They could hardly be treated with proper discretion any more. I note here – I will not elaborate on this point – that while some teachers may have been hurt by such a profound change (they had to teach what they had no knowledge of just some time before), many saw it as a way of raising the prestige of a traditionally disparaged profession, especially, in primary school, because the most educated parents, who might have thought they could do as well and better than their children’s teachers if only they had had the time, suddenly found themselves, for the most part, at a distance – they knew nothing, as a rule, about calculating in a base other than 10, for example... A long time later, a teacher at a vocational school told me without malice that not understanding that a rational number is some equivalence class of ordered pairs of integers, was not knowing what a rational number is! Even from the strict point of view of teachers, the reform was therefore not immediately all negative.

This lived experience could have been a striking but unique event, with no ascendants and no posterity. In fact, I saw it as the hyperbolic manifestation of a phenomenon that is both banal and fundamental: the phenomenon of didactic transposition – I found the expression in a short text that Michel Brossard had made known to us, extracting it from the two-volume work by Michel Verret (1927–2017), entitled “*Le temps des etudes*” ["Studies Time"], (1976, Paris, Champion). What was it about? I will answer by using notions brought in since then by the development of the anthropological theory of the didactic (ATD). How can we explain the presence of a praxeological element $\wp$ in an institution I? Very generally, $\wp$ has not been created from scratch in I. Typically, it has been shaped in I from praxeological elements $\wp'$, $\wp''$, etc., playing a similar role but living in other institutions I′, I″, etc. We will then say that $\wp$ is the result of an institutional transposition in the institution I of praxeological elements $\wp'$, $\wp''$, etc. Several major laws govern these transpositive processes. The most fundamental is undoubtedly this one: the praxeological element $\wp'$ living in I′ there "benefits" from an environment—which today would be described by a set $\mathcal{C}'$ of conditions and constraints—that does not exist identically in I, so that the transposed praxeological element, $\wp$, will have to be able to live in a different environment, identified with a set $\mathcal{C} \neq \mathcal{C}'$ of conditions and constraints. Hence the changes that $\wp'$ will have to undergo to become (roughly) compatible with $\mathcal{C}$. The second law is that the praxeological element $\wp'$ to be transposed must enjoy, in the institutional world where the transposition takes place, a prestige great enough to legitimise this "borrowing". In order for the (relative) prestige of $\wp'$ to be (partially) transferred to $\wp$, $\wp$ still has to be "reminiscent" of $\wp'$, usually through the use in I of signifiers close to those used in I′. We shall see that this will be a source of illusions and difficulties.

In general, when an institution I incorporates a transposed $\wp$ of a praxeological element $\wp'$ living in an institution I′, the aim is to use $\wp$ as $\wp'$ is used in I′, or thereabouts, that is to say, to perform a certain type of tasks T. In relation to this generic situation, we speak of didactic transposition of $\wp'$ into $\wp$ when the aim of I is to teach $\wp$ to a certain audience of students in I, which is a very particular use of a praxeological element. I will then say that I is a didactic institution relative to $\wp$. Two remarks must be made at this point. On the one hand, I is the site of a host of institutional transpositions that are in no way didactic—a school may, for example, acquire a certain piece of software not to teach it to its students but to use it in its functioning. On the other hand, in every institution I, the didactic is present, addressed to I's subjects who will have to use an institutional transpose $\wp$. Having noted this, how does a didactic transposition differ from a non-didactic institutional transposition? In this second case, the transpose $\wp$ (the addition of decimal numbers, for example) of $\wp'$ in I is a (simple) means of I's life (for example. the teacher sums up the expenses incurred for a school trip). In the first case, on the contrary, $\wp$ (the addition of decimal numbers, again) belongs to the order of ends, that is to say to what allows I to achieve its "social mission": teaching (the addition of decimals) While in the second case the choice of $\wp$ is in principle an internal matter for I, in the first case this choice exposes I to the judgment of the outside world—and we know that, as a rule, such judgments are legion! Hence the fact that the prestige of $\wp'$ and the prestige that $\wp$ inherits is a key, even vital, issue. In post-Renaissance societies, where science is the legitimising institution par excellence, the praxeological element $\wp'$ is almost always a work due to what I have called "scholars": $\wp'$ is a scholarly praxeological element, $\wp$ a taught praxeological element. In this case, the “distance” between $\wp'$ and $\wp$ is often substantial: for example, $\wp'$ is what specialised adults use, whereas $\wp$ should be within the reach of non-specialised pupils of, say, 13-14 years old! This potentially disabling distance must therefore be denied. Such a “transpositive denial”, namely the fact that $\wp$ would indeed be essentially "the same thing" as $\wp'$, implies a complex organization: the process starts in the noosphere, where $\wp'$ is designated as “to be taught”, then is expressed in various official or semi-official texts (curriculums, textbooks, etc.) that carry this claim, and finally is more or less faithfully embodied in the concrete teaching provided in the classroom. The success of this didactisation saga, as we shall see, is at the same time the weak point of any didactic transposition.

The theory of didactic transposition put forward a principle that the ATD would continue to explore. This principle can be expressed in a few words: what happens in a classroom cannot be explained only by what can be observed in the classroom. As suggested by the scale of didactic codeterminacy proposed today by the ATD, there is an interaction between different systems of conditions and constraints originating at different levels of the scale: pedagogy, school, society, etc. Even more so, for example, one cannot explain what this student says or does by his or her "thinking". Why doesn’t a professor say that a rational number is the ratio of two integers *a* and *b*, with $b \neq 0$? Why does he say that to say this is not to know what a rational number is? Obviously, because of the conditions and constraints under which he "thinks", which, in this case, have been created by the New Math reform. The ATD generalises this remark: in order to understand the didactic, we must look at the didactic world as subjected to a multitude of systems of conditions and constraints. And these systems of conditions and constraints must be studied and modelled: this is the initial formula that will provoke the development of the ATD, notably through the notions of object, institutional position, personal or institutional relation to an object, praxeology, etc.

Over the last two decades there has been a growth and dissemination around the world of theoretical models developed by you and your collaborators on the ATD. In your opinion, what factors have been important in making this happen?

Yves Chevallard: In fact, it is necessary to examine at the same time the conditions that may have favoured a positive reception or a hostile, even hateful, rejection. Generally speaking, the role of a scientific theory is to allow the deconstruction and reconstruction of the domain of reality of which it claims to be a theory. The emergence of a theory should in principle first give persons and institutions the means to deconstruct their relations to different objects in this field of reality. From this point of view, the effect of the theory of didactic transposition has been dazzling, both positively and negatively. In particular, some noospherians who heard about it became very angry with it. Why was this? In 1985, we were again in a period of curricular stasis, even if the memory of the upheavals of the 1970s had not disappeared. In other words, the relation to the objects taught had reverted to the simplicity engendered by the phenomenon of naturalization: multiplication is that, and nothing else; and likewise factoring, etc. But the slightest question could undermine this quiet confidence. For example, in Grade 8, students were asked to factor the expression $x^2 - 4$, and to show that it can be written as $(x - 2)(x + 2)$. But why were they not then asked to factor, for example, the expression $x^2 - 5$, when they were supposed to know that $5 = (\sqrt{5})^2$? I'll pass. That there is not "multiplication", "factoring", etc., but what we would call today various praxeologies designated as such, which can differ from institution to institution, that the knowledge of which the teacher should present himself as the "master" is not everywhere identical to itself, all this was difficult to accept, at least for a certain number of noospherians who saw themselves as "super-masters" of knowledge. I would add that "scholarly knowledge" is not the "real" knowledge either, and that it can be, under certain conditions and constraints, irrelevant, bizarre or even unusable.

The first repellent factor for a new theory is that it challenges what has been taken for granted until now. At the same time, of course, this is a fact that can be seen as liberating, and therefore attractive. Hence there are usually those who are indifferent, those who are "against", but also those who are "for", those who are passionate. As far as the theory of didactic transposition and, later, the anthropological theory of the didactic are concerned, the indifferent ones were and remain for the most part the didacticians of mathematics for whom a research study combines two ingredients: mathematics (in general, in small quantities) and students. The mathematics involved is a given, of which there is almost nothing to say – because, like teachers, researchers assume that they "know" it in advance. The real object of study is therefore the students, what they do and say, what they believe, etc. A very large part of math education research, all over the world, falls within this restrictive framework, where the adjective "anthropological" has no place. In contrast, the ATD has been welcomed in some parts of the world, particularly in the Spanish - and Portuguese - speaking worlds, thanks in particular to the hard work of groups of aficionados led by a few charismatic individuals, of whom Marianna Bosch is undoubtedly the unsurpassable paragon. To this expansion, there is a limiting factor that I would like to underline: like the theory of didactic situations, the anthropological theory of the didactic is difficult to grasp and master sufficiently for it to become an effective tool of the researcher's work. In this respect, it seems that an all-or-nothing law governs its virtuous dissemination. In truth, this last statement deserves to be tempered. From the outset, at the end of the 1980s, the emergence of the theory of didactic transposition solved a problem that arose for those who had to teach "the didactics of mathematics": what could be taught? Like any other "theory", presumably, this theory provided them with a ready-made chapter, which, as always, had to be adapted to the conditions and constraints of the teaching in question – which was an inevitable episode in the didactic transposition of the theory of didactic transposition...

In contrast, one factor in the felicitous dissemination and reception of the ATD is, of course, what it allows us to do, what it allows us to deconstruct and reconstruct. I will elaborate on this point when answering the fourth question formulated by Marilena and José Luiz:

Can you tell us a little about the challenges and prospects, both theoretical and practical, of studies and research in the didactics of mathematics, particularly in relation to the ATD?

Yves Chevallard: What we can expect in the development and dissemination of the ATD is undoubtedly manifold, but I would like to highlight especially this: the ATD allows us to think up a historically fundamental change in the school paradigm, the transition from the paradigm of visiting works, which is still largely dominant, to the paradigm of questioning the world, which is beginning to emerge—not unambiguously. Instead of studying pre-designated works, we study questions which, for those we are addressing, have an objective relevance (independent of their subjective tastes and desires), the works to be studied not being chosen in advance and somehow "hidden" behind a contrived question, but being those that, in the inquiry into those questions, turn out to be useful for answering, and which are then studied as much as is useful for answering (which does not mean "studied less than in the paradigm of visiting works" if those works were previously studied in that framework). This historical change must have two major interdependent consequences: a permanent and well-controlled redefinition of curriculums (defined by the list of questions to be studied, which implicitly define the works to be studied and the appropriate degree of depth of their study) and an adequate cognitive and praxeological equipment, which enables everyone to know the world more effectively – while the very rich equipment formally generated in the paradigm of visiting works seems to remain indefinitely waiting for a vital use, until the moment when it vanishes from our memories.

The word subjection can, in everyday life, give an idea of submission, and therefore, of powerlessness, but you have said that "our subjections are the means - and the only means - of our power." Can you say more about the notion of subjection and why any subjection can give power?

Yves Chevallard: The use of the word subjection in the ATD may indeed seem contradictory to the ordinary uses of the word, which are themselves in line with the etymology (the medieval Latin subjectare means "to put under"). But the choice of this word, whose meaning is then slightly displaced (one does not submit to a person first, but to an institutional position), is intended to dispel an anthropological illusion, which would lead us to believe that the freedom of a person is synonymous with the absence of subjections! Each of us is subjected to a host of positions: he or she is the child of his or her parents, the father or mother of his or her children, the husband or wife of his or her partner, for example. The same person may be subjected to the position of teacher in one institution and to the position of student in another. Where is the power? Where is the freedom in that? It is because I am subjected to a certain position that I can do certain things (and not others). As a student, I can ask my teacher questions; as a teacher, I often have no one to ask questions to, which is a form of powerlessness. To gain some power in this respect, I can subject myself to a working group (at the IREM, for example). A young man lives with his parents: he is subjected to the position of son. As time goes by, this subjection weighs on him (here we find the ordinary meaning of the word); he will therefore seek to subject himself to a new position, which will free him from this subjection—which, for years, has been vital for him. This new subjection may be diverse: he may, for example, start living with his girlfriend. This subjection (as a partner in a couple) will mechanically alleviate the one he could hardly bear (as a son living with his parents): it then functions as a liberating counter-subjection. This interplay between subjections and counter-subjections is fundamental. Certain subjections are, of course, almost impossible to overcome in a given state of development of human societies: it is because we are subjected to the Earth's gravity that we can walk, run, and jump. As a rule, in order to free ourselves, to acquire new power, we seek new subjections. This phenomenon is evident in the notion of "project". More specifically, in order to free ourselves from a dominant theory in a given field, we start to study another theory that is new to us. To study the ATD, for example, is to free oneself from older views, and thereby gain renewed power of thought and action. I cannot resist inviting the reader to watch the video modules available at https://www.mathunion.org/icmi/awards/amor/yves-chevallard-unit: they are the result of the inexhaustible perseverance and energy of Jean-Luc Dorier and the tremendous and inspired work of Marianna Bosch, whom I cannot thank enough.