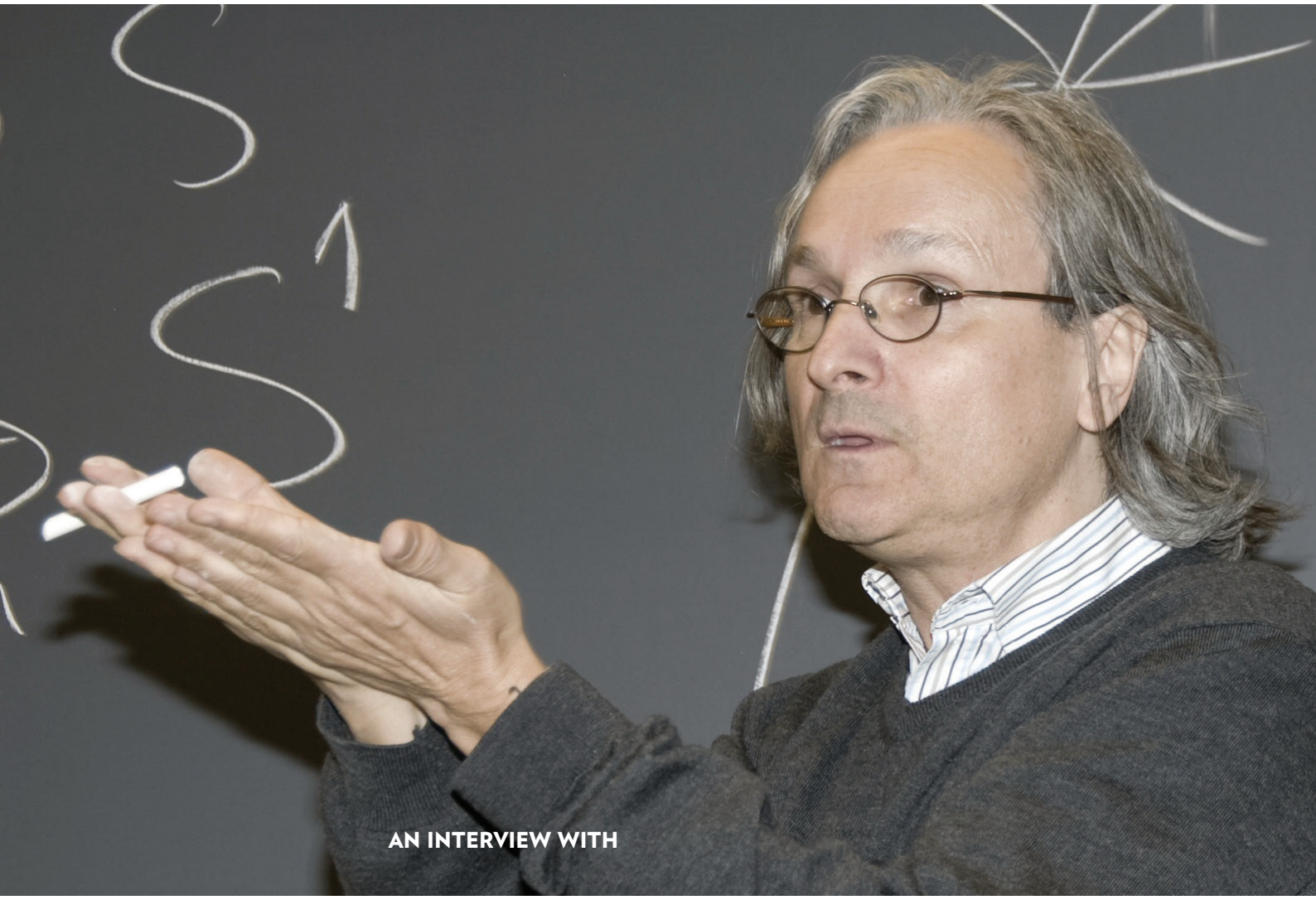

AN INTERVIEW WITH

Étienne Ghys

by **José Ferreira Alves***

Étienne Ghys (born 29 December 1954) is a French mathematician recognised for his outstanding contributions in the fields of geometry and dynamical systems, as well as for his exceptional role in the dissemination of Mathematics.

Presently, he is a CNRS Directeur de Recherche at ENS, Lyon. His impressive research has lead to many distinctions and awards, such as his elevation to the french Académie des Sciences in 2004, the title of *Chevalier de la légion d'honneur* in 2012, the invitations as a speaker at the ICM of Kyoto, as a member of the program committee for the ICM in Hyderabad, as a member of the Fields Medal committee in 2014 or the prize *Prix Servant of the Académie des Sciences*. He is an honorary member of several prestigious societies around the world and was distinguished as doctor honoris causa by the University of Geneva, in 2008. He has served as editor of several prestigious journals such as *Annals of Mathematics* and *Publications Mathématiques de l'*IHÉS.

His work in the promotion of mathematics is remarkable and was distinguished with the *Clay award for dissemination of mathematical knowledge*, in 2015, the *Prix du livre audio* 2011, the *Prix d'Alembert de la* SMF, in 2010. His series of films, produced with Aurélien Alvarez and Jos Leys and published as DVDs and online in many languages, has had a huge impact on high school students. The first, *Dimensions*, has been downloaded more than a million times.

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Personal

How did you become a Mathematician? In particular, how did you get interested in Dynamical Systems and Geometry?

So, these are two different questions. How did I become a mathematician? It was not a decision. I was a good pupil at school and I made no positive choice. When I was a kid I loved science, any kind of science. Could be Physics or even Chemistry . . . . I remember people asking me "what do you want to do when you grow up?". My answer was "I want to be ingénieur". Because in my family, which was not a rich family, the closest to science was engineering. Then it was a progressive decision: when I was at Mathématiques Supérieures I just understood that what I loved in Physics was its mathematical aspect. So my decision was not as a yes or no question, I went to Mathematics in a progressive way.

Now the question about Dynamical Systems and Geometry. I am sorry to say, it is not related to the field but to a human contact. I was a student at École Normale Supérieure, in Saint-Cloud, I had a girlfriend—who is my wife now—, she was in my home city, Lille, I was in Paris and I was unhappy. So I said to the director of the Math Department in École Normale Supérieure, "maybe I could come back to Lille", and he asked me why. I answered "because my girlfriend is there" and he found it a good idea. So I went to Lille and I got a letter of recommendation for professor Gilbert Hector. I liked him and he was doing Geometry and Dynamical Systems: foliations. So what I did choose was the professor and not the topic. I like Mathematics, of course, but I like even more the human contact.

Besides Mathematics, which I think you do not see merely as a job, but also as a hobby, what are the other interests that you have?

To be honest, none!

No other interests?

Well, I am interested by many other things of course, but not as much as Mathematics. You know, if I would tell you that I like cinema, it would be true, but not as much as Mathematics.However, I can say something: the older I get, the more I am interested by Philosophy.

I know that you speak Portuguese very well. As you, many other top French mathematicians (Bonatti, Gambaudo, Yoccoz, who recently passed away, unfortunately) speak Portuguese fluently. This is not just a coincidence. Would you tell us the reason for that?

The reason is not quite the same for all these people. Well, officially it is the same thing, but in my case, when I was a student there was a compulsory military service in France and I was 100% anti-militarist. For example, in France we have École Polytechnique I didn't want to be a student in a

military school. So, one of the possibilities, not to have the military service, was to choose the so-called Coopération Scientifique: instead of staying one year in the military service we could go two years to a teaching position, typically in Algeria, Tunisia . . . North Africa. In my case, because my advisor had spent a year in Rio de Janeiro, at IMPA, he suggested me to go there. Fortunately I could go there and it was a great success. I spent two years there not in military service but in scientific cooperation. The motivation of Jean-Christophe (Yoccoz) was somehow different: he also came in Rio to replace military service, but I believe that Jean-Christophe was not as anti-militarist as I was. Probably, the same happened with Christian (Bonatti).

What about today?

Actually, today there is no more compulsory military service in France: good news! I think that IMPA somehow lost a natural source of young French mathematicians.

But since then IMPA has established strong relations with France . . .

Yes, but not with the very young. When I came there I was only 25.

Now French mathematicians do not go there so young, maybe not so keen on learning a new language.

Yes, I think so. Now they hire post-docs, and there are not so many French post-docs at IMPA.

Mathematics

The History of Mathematics has a lot of mathematicians that we admire. You seem to have a particular admiration for Poincaré, is it true?

Yes, it is true. Maybe one of the reasons why I like him is because his proofs are frequently incorrect, but not his ideas! So, I like his style, not because of the mistakes, of course, but because he is like a discoverer that goes in the forest without taking too much care of what is behind him.

We could say he was more concerned with the ideas than with the formalism.

Yes, his formalism is reduced to the strict minimum. When I read a paper by Poincaré I know that there is a good probability that it might be slightly incorrect and I have to stay alert and I have to question any single sentence. This is very different from other mathematicians.

You are recognized for many valuable contributions to the divulgation of Mathematics, not only with talks, but also with texts and movies. What is the importance of mathematical divulgation for you?

I want to be honest: one of the main reasons for me is that it helps me to understand. I discovered that when I try to explain things to others I understand better. There is a famous sentence by Gergonne, a French mathematician form the 19th Century, he said something like "no mathematician can claim that he understands something, unless he can explain it to the man on the street". Of course today it is more difficult, but the idea is still valid. Many times, trying to explain things to others made me understand better.

Mathematics is the art of having good ideas to solve problems, but also the art of telling other fellows the solutions. Of course not everybody has excellent skills for both. But don't you think that some of our colleagues neglect this second component of Mathematics?

Not some . . . most! [Laughs].

I was trying to be kind . . .

I think it is dangerous, because some mathematicians can get lost. As if they go along a trail in the forest and they don't take care of explaining to others. They go so far that nobody can follow them, and they don't even take care of cleaning the path behind them. They might get alone in the forest! I don't give names . . .

I have several in mind . . .

. . . but many mathematicians get isolated form the others.

It is a pity, because Mathematics is an art, sharing is important.

Poincaré was not like that. It is impressive to note that he frequently gave public lectures or wrote elementary papers in order to explain his main ideas. One good point with Dynamical Systems, Geometry and Topology is that it is somehow easier to explain.

For people on the street we have some nice sentences.

Unfortunately, always the same! [Laughs]

Since Poincaré, the field of Dynamical Systems has developed a lot and got recognition from the mathematical community with several Fields Medals awarded to dynamicists. What do you think are the main challenges for the field in the next decades?

It is a hard question. I am not sure that you will like my answer . . .

Well, I am here as a journalist . . . [Laughs]

. . . but I would say that it is important to reconnect the theory of Dynamical systems with Physics. The origin of Dynamics is clearly Physics—Celestial Mechanics in particular—and it seems to me that many experts in this field have lost contact with physicists. I think it could be a priority now. For example, one could question the relevance of these contributions on the C^1 generic Dynamical Systems for Physics. It is certainly interesting from the mathematical point of view, no doubt, but is this what we want to do? Do we want to go in the forest and get lost? So, my main comment would be, please, do not forget where we come from: Physics.

Let me say something in favor of our colleagues: it is true that mathematicians sometimes go very far and get lost in the forest, but historically it happened many times that people from other fields came to rescue the lost ones. For instance, the theory developed by Einstein used Mathematics that could possibly be considered lost in the forest.

Yes, but I do not completely agree with you. Einstein was essentially using Riemannian Geometry but Riemann's motivation was essentially Physics. Look at the story of the Lorenz attractor. We know mathematicians have been blind, not listening to Lorenz for more that 15 years. Why? Because it was Physics?

The same thing happened with Hénon.

Yes, the same thing with Hénon. Some mathematicians are proud of that: "oh, we are mathematicians, we don't need the physicists".

More generally, what do you think can be the hot spots of mathematical research in the near future?

I will give you a similar answer: to reconnect with reality. It seems to me that, specially, French Mathematics has been very abstract. I believe, too abstract. So, my opinion is that we need to come back to the concrete reality, to extract from it interesting mathematical problems.

Portugal

When was your first visit to Portugal?

My first visit to Portugal was in August 1992. I came for a conference on Dynamical Systems held in Porto.

How do you see the scientific development of Portugal in the meantime, specially in Mathematics?

Let me be honest: away from Mathematics I know almost nothing about Portugal. Regarding Portuguese Mathematics, 30 years ago it was invisible. Now it is visible and I think it plays a significant role in European mathematics. It is going in the good direction.

In Portugal, there are just a few purely research permanent positions, in contrast to the French CNRS. What do you think about that?

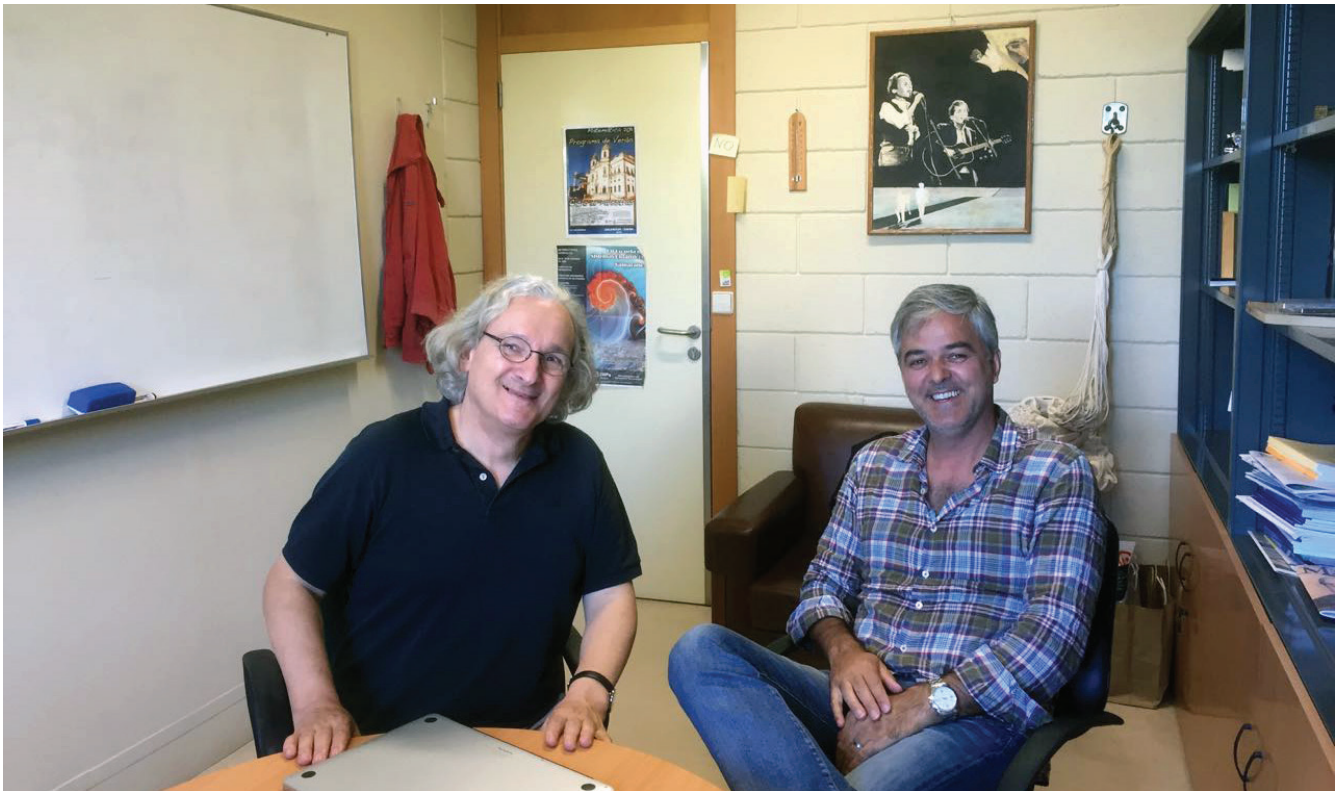
It is hard for me to answer this question. I have been a CNRS member since the beginning of my career. It is difficult for me to . . . as we say in French, cracher dans la soupe. I was hired a CNRS member before my PhD, before I wrote a single paper. I got a permanent position when I was 22 years old, can you believe it? I cannot criticize it, because I am happy with that, but I think it is too much. Let me tell you a story. I was working on my PhD thesis in Lille, working alone, and one day Dennis Sullivan came to Lille as a member of a jury of a PhD. It happens that I discussed with him and he liked what I was doing. And when he came back to Paris probably he took his telephone and I was hired. I got a permanent position because Dennis Sullivan liked my work, with no publications.

Let me say that the intuition of Dennis Sullivan with respect to that is not negligible.

Yes, but that is a good question: can a permanent position be given to a young guy at the age of 22?

That is a risk, and maybe because of running that risk France succeeds so well in Mathematics.

Yes, that is a risk, but I could give you a lot of not well succeeded cases. I remember once I was hired as the president of an evaluation committee of the Institut de Mathématiques de Jussieu, which is probably the biggest Math department in the world. The director of this department at that time was Harold Rosenberg. I was discussing with him and I said "how lucky you are, you have such a great number of excellent CNRS members". Harold answered me "by definition, you know those that you know and you do not know those that you do not know". And then he told me "look at the list of CNRS members in my department, and you will see a



lot of people that you have never heard of". It maybe be good to have such a CNRS position for 10 years, say. No obligations, no teaching for 10 years would be good. After 10 years, a committee could evaluate your work and decide if it is wise for you to continue in such a research position.

For some reasons (financial, demographic . . .) only a few positions for mathematicians have been opened in the recent years in Portuguese universities. On the other hand, the PhD programmes in Mathematics have grown and have become quite successful. Do you have any advice for the young Portuguese researchers who have just finished their PhD in terms of career opportunities?

My first answer would be that PhD is not necessarily an opening to academic. Society needs mathematicians. We do not understand enough that a PhD in Mathematics does not necessarily have to go to a university and to do research. For example in Switzerland or Germany, I think they have a different idea, most of their PhD's go to other kind of jobs. We have the same problem in France. We should try to understand that PhD is an opening to many different careers. The second answer is that the world is great. For instance, Portuguese can go to Brazil, there are many positions in Brazil. Many universities in Brazil need young PhD's and Brazil is a great country. So, go there!

Social

There are historical reasons to explain the existence of not many women doing Mathematics in the past. Though the world has changed a lot, there are still much more men than women doing research. For example, there was only one female Fields Medal. What do you think can be done to correct that?

I learnt recently that Portugal is actually the best in Europe from this point of view. I heard that among mathematicians in Portugal, 47% are female. In France it is only about 20%. If you go to Pure Mathematics, in France it is closer to 5%. If you go from the purest to the most applied you will see also a difference in the proportion of women. In Number Theory, the number of women is very small. But if you go to Applied Mathematics you have a more reasonable proportion of women. I think this is probably because we give an image of what Pure Math is if compared with Applied Math and I believe that men are the main responsible for that. It is always a big discussion, people explaining that it is not their fault and that the fault comes from the lower level. So, primary school would be the problem? I am convinced that the problem is everywhere, from primary school to the university. As an example, the 2017 promotion of the École

Normale Supérieure contains 40 students in mathematics: none of them is a female!

That is a problem of society, in general.

Now how to solve it? I do not know. Recently I was in a committee and there was an English man there. He told me something interesting: in England, professors belonging to a hiring committee have to attend a two hour class, a psychology class or something like that. Most of my English colleagues told me this is very useful. You go there, you spend two hours and the teacher helps you to understand your own stereotypes. This is compulsory, English professors—male, and probably female too—, have to participate in this kind of tutorial before going to any hiring committee. I suggested that there should be something like that in France. For example, CNRS could organize this kind of stage or formation. I think mathematicians, in particular, have to learn how to detect their own implicit stereotypes. Well, this will not be solved soon.

It takes generations some times.

Have you seen the statistics of CNRS? The number of females in the CNRS have been steadily decreasing in the last 30 years.

It is a pity that Mathematics is not profiting from a big part of the population.

Pure Mathematics is terrible from this point of view.

In the recent years, the Mathematical and the scientific community in general have been overwhelmed with the use of bibliometric data to assess and evaluate individuals and institutions. What do you think about that?

I hate them. This is ridiculous. I do not understand how it is possible to do that. Well, let me be a little bit more subtle. I think it might make sense to evaluate a department, but it is dangerous and bad for individuals. I think for evaluating a Math Department of 50 people, for example, it could make sense. But, be careful, to evaluate an individual I think it is nonsense. The good news is that, at least in France, committees do not use it.

I was recently told that the next evaluation of FCT, in Portugal, will not use it anymore. Aparently they are aware of the problems.

For example, CNRS mathematical hiring committees don't use these numbers! Using numbers is specially bad when you have to compare a mathematician, for instance, with a chemist. Chemists usually publish 500 papers!

Well, that cannot be compared.

But some people do it!

The success of Mathematics happens in two main directions: fundamental research and applied research. They are closely connected and the history of Mathematics proves it. However, in recent years there seems to be some pressure by the financing institution to direct the work of Mathematician towards fields of immediate application. What is your opinion about that?

If you want me to say that fundamental research is more important that applied research, no! One should remind our colleagues that it is not a sin to have applications. Doing Mathematics for pure pleasure of doing Mathematics with no use, is it what we want to do? I agree with you when you mention the word immediate. I agree that it is not a good idea to force immediate applications. Gauss or Poincaré were always mixing everything, pure and applied. My feeling is that we have to teach our purest colleagues that applications might be reasonable. I am in favor of applications, not in favor of forcing applications immediately.

What is the question I did not pose you that you would like to answer?

Could it be some personal question?

Yes, sure!

I am more than sixty now. I often ask it to myself what is in common between my approach to Mathematics now, what I like in Mathematics, and what I used to like when I was 15. You know, I have been in love with Mathematics for 45 years and the Étienne of today is very different from the Étienne when I was 15. And the kind of things I was liking

when I was 15 is totally different from the kind of things that I like today. What is common?

This might be significant for our earlier discussion, when you hire a young mathematician. When I was in my 20's, I was somehow competitive, I wanted to prove theorems, if possible before the others. Now I am more like contemplative and I love reading, understanding and explaining the papers of others. This is something we should take into account when we try to evaluate careers of our colleagues, that we cannot use the same kind of criterium when we evaluate a young mathematician and an older one, because they do not have the same goals in their lives. Now, maybe more from a personal point of view: how is it to become old in Mathematics? Probably, I think (i.e. I hope) it is not yet my case! But we must admit at some moment that a mathematician becomes less active, not as creative as he used to be. It is a fundamental question for a human being: how do you get old? Aging in mathematics is rarely discussed. In my case, the older I am, the more pleasure I have in reading old books from the 19th or 18th centuries.