



An Interview

with **Jacob Palis**

by José Ferreira Alves [Universidade do Porto]

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You have started your undergraduate studies in Electrical Engineering. What made you choose your way in Mathematics?

Well, perhaps we should not say Electrical Engineering, because I didn't finish it. I shifted to Economical

Engineering in the meantime. Anyhow, since I came to Engineering School, I had the idea that that was a place for Mathematics — to some extent for Physics too, but specially for Mathematics. This idea was offered to me by my second oldest brother, who was an

Engineer. Actually, very successful that time, later on he became a politician. For a while he was quite a brilliant Engineer and I couldn't see otherwise. I came from the interior of Brazil, so I went to Engineering because that was ready.

But did you have Mathematics in mind from the very beginning?

Oh, I loved Mathematics since I was a kid! Because of that, my brother convinced me that I should go to Engineering. It was as simple as that. Of course talking about Brazil of the early fifties, that is quite a long time ago. To make it brief, you know, at that point families had the idea that if you like some kind of Biology you should go into Medicine and if you like Mathematics or Physics you should go into Engineering; otherwise, you would go into Law. As simple as that. Me and my four brothers, we went exactly that way. We went to Engineering, to Medicine and one to Law, and that was the picture. In Engineering School I used to ask questions, being sometimes audacious but never being impolite or improper, in the sense of not appreciating the teacher. But I did ask a number of times embarrassing questions, apparently. And so by the end of the Engineering course, although enjoying the course, and enjoying specially the last part on economical engineering, I developed the taste for Mathematics. I went to participate in seminars, at IMPA already and at some centers for physics also. I formed the idea that I should study Mathematics and Physics and then go back to Engineering to see it better and to know how to answer some of my questions. I was not able to get good answers from the professors at the time. Anyhow, my family was very surprised with the idea, because at that point I already had several offers to work in Engineering, but I convinced them that it was reasonable to get a fellowship and go to the United States to study Mathematics. So, that is how the story started.

How did you get in touch with Steve Smale?

Since I have decided to go to do Mathematics in the United States, I inquired who was the best mathematician that had visited Brazil in recent times. Then I was told it was Steve Smale, and I wrote him asking if he would be my advisor in the University of Columbia. Looking back it is amazing how I dared to do that myself. Anyhow, the answer was yes. He certainly consulted people he knew in Brazil, but I don't know about that. Then at the last moment he moved to Berkeley. That again was interesting, because there was no more time to apply for Berkeley and he had to

negotiate the acceptance from Columbia University to Berkeley. He succeeded and I went there. Well, I was not a mathematician, my education was not complete, there were some fronts where I felt extremely well and others where I felt I had to start from scratch. Somehow I survived in the three years I completed my PhD, together with the master degree, which at that point was not much.

Did you make a personal choice on Steve Smale, not conditioned by the area he was working in?

Your question is very appropriate. Of course, among the courses I had at IMPA, one by Peixoto was on Dynamical Systems and I liked that. Peixoto at one point said: "This topic will not be covered because is too hard". So, I went home and I did it. It was the Unstable Manifold Theorem. Later on I learned it in more sophisticated ways, but I did it with the instruments I had at the time. I liked that. Of course, I had some good courses in Algebra, good courses in Topology and Differential Topology, but somehow I liked the fact that he had visited IMPA in Brazil.

Steve Smale was already working in Dynamical Systems?

He was definitely working in Dynamical Systems. When he visited Brazil he was in a transition from Differential Topology to Dynamical Systems. Anyhow, the reasons sound like not very deep ones, but that was the way I would go ahead. I went to the United States and I did it quite well. My thesis was well accepted and immediately it was generalized by myself and my advisor and we formulated the conjecture. That was interesting. This shows how I was, I proposed it to Smale and he said: "Well, let's do it". What was called the Stability Conjecture became really one of the main sources of research for the next 20 years, and it was finally well solved in some interesting way — not completely, but... — by a student of mine: Ricardo Mañe. So that was the first big question I was involved in asking.

Did you think about staying in the United States?

Then I got some good news from Brazil in terms of more support for science. The National Bank for Development initiated a new program in Economical Engineering that was precisely this way. Some of the economists convinced the bank to put a percentage of its budget — this was quite huge — into basic science and basic engineering. This was good news and then there was the organization of a graduate program — sometimes we call postgraduate program —, another interesting

fact. I did get some offers to stay in the United States but I was not really available and with some good news from Brazil, together with the bad one that we had a dictatorship in 1964. But, on the other hand, the organization of the masters and PhD programs in Brazil was done in a superb way, because they did focus in the best groups not on institutions. Usually institutions are very heavy. I was surprised because I thought the University of São Paulo and all its doctorate courses would be immediately approved, but it was not that way. The choice was made on the existence of good groups of researchers.

That made you feel even more confident about returning to Brazil.

Sure. At that point, another good memory I have is that going to bookshops in Berkeley I found this little book called *The Double Helix*, by James Watson, which was the story of how DNA structure was found. A little book I was reading, it was not long and it let me curious for a few days. There were some gossips inside and whatsoever, but that was not the point that took me. It was the fact that he described quite well — very well in my opinion — the atmosphere in Cavendish Laboratory. This was really what I always talked: one should have some kind of magic in the ambience for the young talents to pursue science. Perhaps we could do so in Mathematics and other areas in Brazil. So I decided to go back and try to contribute with some creation of a magical place for Mathematics in Brazil.

I must say that this fits perfectly well the opinion I have about you. An informed opinion, since I got my PhD at IMPA.

Thank you. I didn't even listened to the offers that were made to me. I was not available. But I stayed ten more months in the United States, in the East coast. To make brief a long story, I went to visit Brown and MIT, specially these two places (I also went to Harvard...), mostly in Brown to some extent. In February I returned to Berkeley, they had offered me an Assistant professorship which I took. But I kept saying that I was going to quit in August and return to Brazil.

There was always in your mind the idea of returning to Brazil...

Basically yes, but as I told you, around 1967, when I was about to finish — I finished in September — I heard some good news from Brazil and as soon as I finished I also got an offer to go back to IMPA and another offer to go to the Federal University of Rio de

Janeiro. The final decision was really at that point. I had the idea to go back, but I didn't play any game in either way if I would stay or not. But when I got this, basic science was starting to get better funding for the construction of graduate programs in Brazil. Then this little book... I thought I could contribute to create such a magical place in Brazil. I decided to go. Probably I had more chances in Brazil than in the United States, where to some extent this idea was already there in more developed places. Brazil was a bigger challenge and my country. I did return in August 1968 to IMPA and to the University, but quickly I saw that my dream could perhaps be better achieved in IMPA, not so easy to do so at the University, too big. So I quit the University, but people were not happy.

IMPA was not as it is now...

No, but on the other hand it is important to say that IMPA was founded in the right way by three people in 1952. Three good people: Leopoldo Nachbin, Maurício Peixoto and another one more senior, Lélío Gama, a good guy in Astronomy and Mathematics. So it started very well. The point is that IMPA was very good from the beginning, but both Peixoto and Nachbin would travel a lot. They had positions abroad later on. It was indeed a more stable situation in institutions where they could do very good research as a routine. So, that was very important that it started very well with this people playing a very important role. However, it was clear to me when I decided to go back — I started convincing Manfredo do Carmo who came for a postdoc — we had to do very good research on the day by day basis, do it continuously.

You kept a strong collaboration with some American universities with constant visits in both directions.

That is right. It is not a criticism, just a fact: Peixoto was connected to Brown University and Nachbin to New York University — not the State University. My idea was that we should have a Program working regularly. That was the key word: regularity. I should say quickly that we set up a new PhD Program at IMPA in the seventies. Not alone, of course, with do Carmo, Lima and Peixoto that finally came back from the United States. To my surprise, I had immediately wonderful students. In fact, in two and a half years three of them had concluded the thesis. Among them was Welington de Melo, an excellent mathematician, and Ricardo Mañé. That was very fulfilling to have such bright people concluding in record time. There was also Pedro Mendes, very good too. The first one was Welington, the second was Mañé

and this was incredibly fulfilling to me, corresponding to this idea of having a regular program, and that went on without stopping.

Let us talk about Mañé. Is it true that he wrote you a letter saying he solved some problems?

Yes, absolutely! Unfortunately I am not good at archives. This letter was lost when we moved from one building to the other. We were downtown and we moved to the new building in the Botanical Garden neighborhood. The most precious part of my correspondence was in a unique box — which was stupid — and this box was lost. I searched it back and forth and, my God, I was desperate! Inside there was this beautiful letter by Mañé. He didn't even have the master degree, he wrote me a letter saying that he had solved five questions in Dynamics. The first one maybe he had it, I don't know, and that was certainly correct because I had done it before. It was a good question, not a great question. But the other four, each of them would grant him a permanent position essentially in any place. A number of them are open until now, including the Stability Conjecture. These questions are still open in a more general way, but he solved them in some particular cases.

How old was him?

It was the year of 1970, so he was 22. This letter came in an interesting moment. Well, my life is full of special moments. To initiate this new Program I had talked to Peixoto about it. And Elon Lages Lima — a very good mathematician in Topology, always very helpful — was there all the time. Anyhow, we decided to organize an international meeting in Dynamics, in 1971, in the middle of the year. In a certain way, to stimulate students. It was thought to be that way. We would work hard since late 1969 on until 1971. It would be a good time to have very good people to come to Brazil in Dynamics, and more broadly in Geometry also. So, we start preparing these students, among them Wellington de Melo, also very audacious. He came from Minas Gerais to get Master. He came to my seminar and I said “my God, like I did in Berkeley”. I came directly to the seminar of Smale, which was a seminar really about recent research. I had big gaps like Probability Theory and Wellington did the same in Rio. He insisted he could do it, and I agreed. “If you can stand it, amazing”. I'll never forget this fact. I told him: “I did survive, if you can survive...”

The case of Mañé is similar.

Mañé in some sense yes, also. Anyhow, in that letter he showed such a maturity! One of the questions I

remember is open until now. Not solved, except in very few cases: the Stability Conjecture. It is much settled by him, in the C^1 topology is complete. Another one was about Anosov systems: if the periodic points would be dense or not. It is open until now. It is amazing, but he stated the questions extremely well. He claimed that he had good ideas to solve them. I remember specially this two, but there were four or five. I was very impressed. That also showed how I would react toward this situation, certainly not conservative about these things. I took that letter — I was enthusiastic about it — and I convinced Peixoto and Lima that we should invite him for the meeting in the following year.

The famous meeting in Bahia!

Yes, in 1971, the first time I met Mañé. And he was invited without even completing the undergraduate studies. He was about to complete them. People reacted in different ways. Jorge Lewowicz didn't like it because he was in a sense the supervisor of Mañé for what they call *tesina* — it's common in Spanish speaking countries. He didn't like it at all, but I loved it! I convinced people they should know this guy. I was taken by the maturity of the statements, but one has to have good will. Peixoto and Lima told me: “OK, we agree”. Then he came and we discussed one of the topics that I have done but he improved. He asked me what I thought about him going to NYU to work with Moser, and I said: “Well, wonderful!” But instead he wrote me in September of 1971 saying that he wanted to come to IMPA and asking me if I could be his advisor. Similar to what I did. I said: “Sure! I bet on you.” And he came.

Presently, do you still see young students using that method?

No. It is not so common. I think it became more standard. Anyhow, I know these two cases. Maybe it happens still... In a certain sense it happens, but not exactly in the same way. You see these young fellows, Artur Avila and Gustavo Moreira, it is a different story because they won the Olympiads and they came to IMPA very early. They were audacious too, both Avila and Moreira, but they came through courses. Also Carlos Matheus. This two guys [de Melo and Mañé] were more at the level of research, but I agree it still happens.

Just to finish about Mañé: looking back and knowing about his fantastic work from the very beginning, it's strange that he didn't win the Fields Medal. Do you think nowadays it would be different?

I do hope so.

Latin American has no Fields Medal.

No, but I think Artur already deserved it.

This last time?

Sure, a wonderful candidate. Maybe he didn't get it because he was too young.

Still very young...

He is 33 now. Well, the only chance of Mañé, because of age, was 1986. I did talk to Moser about him, and Moser was the chair of International Mathematical Union at that time. You know, not being at a main center is not easy. He was certainly considered. But you have different explanations. That year there were three people, I think, all with outstanding work, so there was a place for a fourth person. Anyhow, one had to do with the solution of Fermat's Problem, not the complete solution, but quite spectacular. Another one was the Poincaré Conjecture in dimension four.

Always Poincaré Conjecture...

Smale had done it for dimension five or more. That was also wonderful without no questions about it. But, you know, it depends a lot on the committee and it depends also on visibility. In terms of visibility, of course the main centers in America win. The Russians took quite a while to get Fields Medal. After Sergei Novikov it became more common. But Sergei, I think, he was the first one, which is strange in some sense because they had very good schools before. Sergei was in 1970, I believe, there were no Russians before. It is a question of visibility, of people knowing also.

There was a wall!

Being outside the main centers is not such an easy task. Now Avila, in some sense we are very happy to have Avila half of the time. Then the idea of being also in Paris I think is very good for visibility too. Not only that, the French school is wonderful. So it is nice. In the case of Mañé, either he would win in 86 or not. The result was spectacular, but also he obtained this result perhaps too close to date of decision. That was only a question of time, it was very short.

Bad luck...

Certainly, I'm sure he was considered. Then there was the case of Marcelo Viana in the year of 2002, very disappointing.

Marcelo has also been considered?

Certainly very much considered. I would say he was on a short list. Then it was given to two algebraists, it's

too much. As a secretary to IMU, eight years before we approved certain obvious principles on how to get the Fields Medal. One was diversity. It's bad for science to repeat the same field and there was no justification for that. I was the president, so I was very disappointed because the chair was Sinai and they did not follow the principle. Now I hope this will disappear with Avila. When they are forming committees, the most natural tendency is to have people from the main centers. Anyhow, to conclude that, certainly Mañé was in the level of Fields Medal, and I insist on saying the same about Marcelo. Now there is Artur and I have no questions about that.

Let us change topic. 1982 was the year of your first scientific visit to Portugal. Tell me about that experience.

Well, I got this invitation by a group, a kind of international institution, a network called Mathematicians of Latin Languages. I didn't quite understand what was that. I knew Lisbon, I got to Lisbon a couple of times but just for vacation, returning from some other places in Europe, but I didn't get in touch with the mathematical community. So I got this invitation for a meeting to be held in Coimbra. I got several invitations before. Some colleagues in Portugal wanted me to visit their own institutions, but I never set any date. Finally in 1982 I said: "Ok, I say yes to his invitation". It's funny, because latter I was told they were not expecting me to accept this time. Coimbra was very attractive, a visible place, the history... Then to my surprise when I got there in Pousada de São Marcos — to me it was a reproduction of a castle, a palace very austere but at the same time with good taste — and there was a very nice cocktail to welcome participants. There was a number of participants to give main talks of the meeting and I was one of them. Then, toward the end of the cocktail one of the main organizers told me: "You know, Leopoldo Nachbin criticized us for inviting you" [laughs]. Because Nachbin was a member of this network and he said someone had a better name than mine. I said: "Well, I am already here!" And he said: "No, no, it's OK. I just mention this for you to know". I said: "I don't care, I'm here, I'm happy". It was like that. In the day after there was the idea of the special group giving the main talks dining there at the same place — the table for dinner reminded me the Tavola of King Arthur! Then we had some activities and I met the young people. I decided to stay with them, in particular with Marcelo and Jorge Rocha. Marcelo was giving a talk, not one of the main talks. He was very young but had very nice results. At the end of the lecture I told him it was very good and so on.

He was already a good speaker, I guess.

Good speaker. Good results for a kid. It was quite impressive. I thought “my god, I go to get dinner with senior people and here we have bright young people”. So I decided to stay with them and I said: “Look, it is a pleasure for me to stay with you, having dinner together, but you have to take me back to this place, otherwise I have to go to a hotel and I offend the organizers”. But when we came back I was sure the way it looked the place was closed. So I suggested throwing little stones at the windows in the back. Luckily, there was someone in the kitchen that opened the door. Absolutely true story! This was very good, because I think we started a very strong connection with Portuguese young people. Maybe a year or two later — I don’t remember exactly — three of them went to IMPA.

Maria Carvalho went to work with Mañé, Marcelo and Jorge to work with you.

That is right. It was a nice story. Again it shows that uncertainty is a very precious thing in life. It’s hard for people; it was hard for me to accept the idea of uncertainty as part of everyday life. All these things I am telling you fit perfectly well this idea that uncertainty is part of live. I think that if you accept this idea, in many cases you can turn it into very good things. Certainly, one of the best things in my life was to accept that invitation.

That’s fantastic! It was almost 30 years ago. How do you see the development of the Portuguese Mathematics in the last 30 years.

Immense! It is absolutely another world. Potentially, of course, people were here, but the number of good researchers in Mathematics now is very impressive. It was a very successful development. It is not a question of criticizing the past; these things were like that in Brazil. But now here is much better. I come and feel at home. I saw people in the lecture today and how people reacted. I think you went a long way. I am not saying that nothing was there in the beginning, it is not true, good people, but much more dense now, much more visible. And you have young people. It is a beautiful thing.

A good way of measuring that is perhaps looking at the quantity of young people involved.

Like the one you introduced me today. He is doing very good things.

Jorge Freitas...

We were talking nice Mathematics just over the coffee, which certainly was not here before. This is almost the

proof of big changes. It is much more active the present caring for young people.

I’m glad to hear that. Let us talk about Mathematics in general. Nowadays we feel a big pressure in Mathematics, as if one should have applications almost immediately. We hear very often: “what is the use of this?” What is your opinion about that?

That is terrible. We should not pursue this kind of topic. I think there is a certain confusion about more basic science — sometimes more pure — or applied sciences. They should live together. I think it is very important to be creative in basic sciences as well as in the Industry or in applications. It’s part of a complex, you have to do both. I think there is a wrong vision often about pressure to have people doing basic science to move to applications. That is completely nonsense. It is obvious that basic science turns into good applications, not necessary by the same people that have created basic science. Then you have to have those things together. No pressure. The pressure does not solve anything. It depends on the talent. For instance, it is very important to have research and development in the Industry. Otherwise, the Industry will be offering the same products over and over again. We know that you need creativity, things move on. Human beings like novelties, new tv sets, very thin, now we have iPods, taking over computers, smartphones and so on. However, you have to have an ambience of freedom, stimulation, and magic as I said, in both sectors, both are very precious and important in a community. They both should be supported and stimulated. You cannot do this part and forget the other one. I cannot understand people being nervous about economies and then say: “We are going to support only applications and patents”. This is nonsense. On the other hand, we do need good people in that part too. Industry should respond to that, should stimulate researchers to come and to be creative. Nowadays the magic word is innovation.

Another place where we see pressure and numbers measuring everything is in the scientific production, as the impact factor and so on. How do you see that?

Very interesting question. Not so easy, because there is a lot of that now. Again, my view is that if you apply, first of all, indicators across different areas you have big distortion, because different areas have different cultures. In Mathematics we tend to produce fewer papers, but they are more complete. It is not better or worse than in other areas, but different culture. In Biology the tendency is to produce shorter results and publish more. Shorter results are not necessarily



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less important. So if you go across different areas you commit a big mistake. And that is what is common nowadays; we have the H factor or the number of citations... On the other hand, if you look more globally and don't mix areas it makes more sense. My view is not for individuals, if you apply this for individuals you are again about to make a mistake, a serious mistake. I like the idea — I think it is a reasonable idea, not wonderful — to have indicators like number of citations in certain areas, for instance, Mathematics, the average in certain countries with respect to the world average. This makes some sense to me. There is some logic in that. Again, indicators always have high degree of uncertainty. Anyhow, this seems to be reasonable to say that more citations mean better journals because better journals are more visible and so it is a tendency to correlate that.

That can also be increased artificially.

Not if you are talking about countries. If you talk about individuals, I don't think any of these things make any sense. But if you talk about a global community, the tendency is to be more reasonable the indicator comparing with the world average in the same area. That is more concentrated in more advanced countries. Everything I am saying makes sense to me, reasonably.

Ok, Jacob, thanks a lot for this wonderful conversation.

It was my pleasure!