

SPOTLIGHT

An interview with Enrico Coen

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Enrico Coen CBE FRS is a Project Leader at the John Innes Centre in Norwich, UK, who uses a variety of approaches to study patterning and morphogenesis in plants. We met with Enrico at the Spring Meeting of the British Society for Developmental Biology, where he was awarded the Waddington Medal, to ask him more about his career and his passion for art and book-writing.

You're here at the BSDB/BSCB Spring Meeting to receive the Waddington Medal. What does it mean to you to receive this award?

It's a fantastic honour. To have my group's work recognised by my peers is a wonderful thing. When I was a student, I was always fascinated by Waddington's research and the way he combined theoretical and experimental approaches, so it is particularly gratifying to receive a medal named after him.

You are the first plant developmental biologist to be awarded the Waddington medal. Do you think that plant developmental biologists are generally overlooked in the field?

Developmental biology, and biological research in general, is dominated by animal studies. People tend to concentrate on their own fields so, in a sense, plant developmental biology does get overlooked. But once people are exposed to the amazing things you can find out about plants they revise their views. I think that plants have got a fantastic role to play in helping us understand development. Their cells do not move so certain problems can be simplified. And because they live in fixed positions, they are very responsive to their environment, changing how they grow, branch or flower, which is fascinating to understand.

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Both your parents were scientists, but in the areas of physics and chemistry. How did you become interested in biology?

Maybe unconsciously I wanted to be different from my parents. One's first entry into biology is normally through things that are familiar to you; I enjoyed having pet animals. I do remember reading *The Chemistry of Life* by Stephen Rose when I was at school. This book had a big influence on me because I realised you could study the underlying mechanisms of biology just as you could for inanimate objects. Gradually, I became interested in trying to



understand complexity and how amazing forms are generated. But it wasn't a clear plan from the beginning.

You did your PhD at the University of Cambridge with Gabriel Dover, on the genes that are needed to make ribosomal RNA in flies. When and why did you transition into plant development?

At the end of my PhD I was slightly disillusioned with science, which is not uncommon with students at this point in their careers. I wanted to do something that was further away from the mainstream biological community, so I toyed with various ideas. I knew I wanted to study genes that were of evolutionary importance and that had clear phenotypic effects. I thought about working with butterflies, but eventually I decided to work on primroses because they were more practical to work with. So, I switched from flies to plants because I was interested in the specific problem of how genes create diverse floral forms. After studying primroses for a while as a postdoc, I realised that perhaps I'd bitten off more than I could chew, and that maybe the mainstream had some merits to it! Eventually, I worked with snapdragons, which weren't completely mainstream but had the advantage of being backed up by better genetics than the primrose system. Funnily enough, now, 30 years later, they have finally solved the problem of primrose genetics that I was trying to study then.

My view of science matured during my postdoctoral years, not unlike our reaction to our parents when we grow up. When you are a child you think your parents are perfect, but at some point you realise that isn't quite true. At first that's disappointing, but then you realise that you are not without flaws so why should they be. These imperfections just reflect the way people are, and I think it is the same with science. Science is done by people, and people are not perfect. In fact, this gives science a human quality. I gradually came to terms with that, and now I actually welcome the fact that science is a very human activity, rather

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than feeling disappointed. Science is a human endeavour and it carries with it all the foibles that are part of being a human activity.

Why are snapdragons a good model system in which to examine plant development?

I decided to work on snapdragons after I went to the John Innes Centre for a job interview. Brian Harrison was about to retire and he had worked on snapdragons with Rosemary Carpenter for many years. They, together with Heinz Saedler's group in Germany, had discovered that transposons were responsible for the variegated snapdragon forms. Snapdragons were therefore a great model in which to understand transposon behaviour. But these transposons could also be used to identify genes. In fact, snapdragons turned out to be a very convenient system for studying genetics. In the early 1900s, the snapdragons were at one point the best-defined genetic system, plant or animal. They have the great advantage of producing lots of seeds, being easy to cross genetically and having a lot of natural variation. But they gradually fell out of fashion, until the 1980s when plant transposons started to be isolated and studied at the molecular level.

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You have made many important contributions to the plant development field. Which of your discoveries are you most proud of?

I don't look back and think 'I'm proudest of this achievement', but throughout my career there have been lots of very exciting moments that helped us gain important insights, or suddenly allowed us to see something new. For example, it was exciting when we realised that you can explain the different types of organs in a flower by combining the gene activity of just a few genes. Another exciting moment took place when we identified genes that controlled flower symmetry, and saw where those genes were expressed. And recently there has been the excitement of trying to integrate theory and modelling in the generation of shape. Normally, when you look at someone's career you may say that they are known for this or that achievement, but for me it just feels like one continuous set of exciting adventures that I've been lucky enough to be part of.

You mentioned that your lab has recently focussed on modelling plant development, using computational approaches. Why this change of focus, and what are the scientific questions that you're trying to address?

Towards the end of the 1990s, we had defined many of the genes that establish basic expression domains in the flower, but the question that bugged me was how you go from a pattern of gene activities to a shape like a beautiful flower, or a heart or a wing. It's a general problem, and studying many sets of gene expression doesn't answer that question. We wanted to understand how gene expression was linked to the deformation of tissues to produce shapes. This was clearly a problem that I was not going to be able to solve just by thinking about it; most of the things we are familiar with, like a table or chair, do not grow or deform with time, so it is very difficult to get an intuitive understanding of these processes. We needed computational tools to help deal with this problem, so I started working with computer scientists, Andrew Bangham and

Przemyslaw Prusinkiewicz, to develop frameworks that could help us to start exploring the properties of growing materials. It has been almost 20 years since we approached this problem and I am still discovering new things about it.

You have been at the John Innes Centre since the time when you first set up your lab. Were you ever tempted to move?

The John Innes Centre is a fantastic place to work. There are, of course, funding constraints, but there's a great sense of freedom that allows you to get on with what interests you. It has a very flat structure, so there isn't a strong sense of hierarchy, which is great. It also has all the facilities that I need to grow my plants and do the genetics and imaging analysis. So why would I move? I think some people move, rightly, because it exposes them to a new environment, with new colleagues and new interactions, and that can be very valuable. I've solved that problem differently, rather like a plant that doesn't move but can branch: I haven't moved but I have formed connections and collaborations with people in other places and in other disciplines. So, I hope I have moved in the academic and intellectual sense, even if I haven't moved physically.

In addition to conducting research you also write science books, providing 'bigger picture' views of science and the world. Why do you write such books?

One of the reasons is to share certain views with a broader community. In a scientific paper you can only share a specific perspective and not your general viewpoints.

Another very important reason is to clarify my own ideas. It's a way to think deeply about a topic, and it's very exciting when you suddenly realise that certain ideas come together in a way that they wouldn't if you hadn't written the book. This is also true when you write a paper, although on a smaller scale. Writing books has also affected my science, because it has allowed me to step back and think about where I want to go scientifically. It can help you to pose your own scientific questions more precisely and more generally as well. We are, in a sense, blind to what we are most interested in, because we are so close to our subject. We are passionate about what we do, and we assume that the rest of the world cares in the same way. Getting other people to share those passions forces you to look at where those passions come from and step back from what you are doing. In book-writing, as in science outreach, you suddenly find that people aren't automatically sharing what you are fascinated by, so you have to connect with them. So an important part of writing a book or doing outreach is to listen to what people connect with.

I have also realised that there is something very addictive about writing books, and I am actually writing another book, although it isn't fully formulated yet. Each book that I have written has led to the next book. My previous book raised certain issues about what engages us in stories and how we tell stories. So I started thinking about stories in relation to science, and now I'm starting to write a book about that, which in fact may turn into a story. It's quite a challenge for me, but I'm enjoying it.

You are also an accomplished artist, particularly of portraits, and one of your books established a metaphor of an artist working on a piece to explain how development works. Have you always had an interest in art? Did you consider becoming an artist?

I have always had an interest in art but I never thought about becoming an artist. Every summer my parents would take the family to Italy, which was a wonderful experience. When I was 13, I remember seeing Giotto's frescoes in Assisi, and later in life I

realised that they were like very well-designed PowerPoint slides. Each of them tells a story in a very beautiful way. I was captivated by those images and how you produce them.

I didn't really do anything about painting until my early thirties. At that point I was starting to do less lab work but I still wanted to do something with my hands. I was also more distant from the frustration you feel when an experiment fails, when you are battling with nature. I missed that sense of challenging yourself, so I went to an evening class and started to do some painting. I enjoyed the feeling of creating a pattern and how its success or failure is your sole responsibility. Whether it is an experiment, a computer program or a painting, they are personal challenges, with their own frustrations and joys.

I mainly paint portraits because I think the human face is just totally incomprehensible. After all these years, I still don't quite know what makes a face look like somebody. I never know at the beginning whether the portrait is going to work out and I just hope that something emerges. It is an act of faith, which is not unlike science. You don't know whether you are going to be able to find the answer and you just have to plunge in and hope that something will come out. But when I do a portrait I have the sitter for only two hours, so unlike a scientific experiment it is very intense and you have less time to make corrections.

Do you have any advice for young scientists?

Follow your passions, whatever they are. You may not be allowed to follow them, and your passions might change or

develop, but at each point in your career try to follow what captivates you. There are no rules about how to make a scientific career work. Normally, people tell you what happened to them and turn that into a rule. But each person is different and in a different scientific situation.

One thing I think that's helped me is being able to see things from different perspectives. If you give yourself the opportunity to experience things from different perspectives you put yourself in a much stronger position. You are able to draw on a broader set of ideas. That is really helpful and can happen in a number of ways, such as by establishing collaborations or changing fields. But that is what I did; so you see, I'm justifying what you should do based on what I did. It's almost impossible not to!

There are no rules about how to make a scientific career work

What would people be surprised to find out about you?

Some people are quite surprised when I say that I was extremely shy at school. People find that hard to believe because I give a lot of talks, but talks are just a performance and it doesn't mean that you aren't shy. I think a lot of scientists are shy. If they were effusive personalities they might have gone into other areas. I like to think that I've overcome a lot of that shyness, but deep down it's probably still there.