Balzan Prizewinners
Interdisciplinary Forum

2014

Ian Hacking
Epistemology and Philosophy of Mind

G. David Tilman
Basic/applied Plant Ecology

Dennis Sullivan
Mathematics (pure/applied)

Mario Torelli
Classical Archaeology

Friday, 21 November 2014
at the Accademia dei Lincei, Rome
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List of Balzan Prizewinners
- for Literature, Moral Sciences and the Arts; for Physical, Mathematical and Natural Sciences, and Medicine
- for Humanity, Peace and Fraternity among Peoples
Cari premiati, colleghi, signori e signore,

sono onorato di portare il saluto di benvenuto al Forum Interdisciplinare dei Premi Balzan 2014. In primo luogo rivolgo le mie più calorose congratulazioni a Ian Hacking, Premio Balzan per l’epistemologia e la filosofia della mente, a Dennis Sullivan, Premio Balzan per la matematica, e a David Tilman, Premio Balzan per l’ecologia delle piante, infine al nostro caro socio Mario Torelli, Premio Balzan per l’archeologia classica. Ma molti altri dei nostri soci, ricordo con piacere, hanno conseguito il Premio Balzan: fra tutti Massimo Pallottino, per le scienze dell’antichità, Francesco Gabrieli, per l’orientalistica, e Paolo Rossi, un caro amico, per la storia delle scienze.

Per circa 50 anni, la Fondazione Balzan ha onorato con i suoi premi personalità straordinarie che hanno dato fondamentali contributi alle scienze, alle culture umanistiche di alto valore sociale. Colgo l’occasione per dire che a me non piace distinguere fra le scienze e la cultura umanistica. Entrano tutte nell’ambito dell’esercizio della nostra mente. Sono tutte scienze umane perché sono tutti esercizi del cervello dell’uomo.

La Fondazione conferisce quattro premi annuali, due nelle categorie di lettere, scienze morali, arti, e due nelle scienze fisiche, matematiche, naturali e la medicina, e un premio periodico a imprese eccezionali di alto valore sociale. Quest’anno il Premio Balzan per l’umanità, la pace e la fratellanza tra i popoli è stato assegnato all’associazione Vivre en Famille, che si occupa da sempre di infanzia disgiata. Il Premio Balzan è destinato principalmente alla creazione di un reparto di maternità e alla riattivazione di una scuola a Ibambi, Repubblica Democratica del Congo. È un’iniziativa veramente meritevole, che stamattina è stata affettuosamente commentata. La collaborazione tra l’Accademia dei Lincei e la Fondazione Balzan ha radici lontane; già prima della sottoscrizione dell’accordo, le nostre due istituzioni lavoravano insieme per il conferimento e la cerimonia di consegna dei premi. Mi piace ricordare che il Premio Balzan per l’umanità, la pace e la fratellanza tra i popoli a Madre Teresa di Calcutta è stato consegnato proprio qui, ai Lincei, nel 1978.

La collaborazione si è definitivamente consolidata nel 2009, quando l’Accademia Nazionale dei Lincei ha siglato un accordo di collaborazione con la Fondazione Internazionale Premio Balzan e con le Accademie svizzere delle Scienze. Grazie a questi accordi di collaborazione, i Lincei hanno potuto incrementare e qualificare le loro at-
attività di promozione culturale in ambito internazionale, cosa che mi rallegra particolarmente. L’accordo di collaborazione con la Fondazione Balzan ha lo scopo di incoraggiare, diffondere e condividere in ambito europeo e internazionale la cultura in tutti i suoi aspetti – di nuovo – scientifico e umanistico.

Per sostenere la cultura e la ricerca scientifica, la Fondazione Balzan ha introdotto l’iniziativa di destinare la metà dell’ammontare di ciascun premio a progetti di ricerca che riguardino i giovani. Ritengo che questa innovazione sia degna di grande rilevanza e considerazione, come ha fatto notare ieri il Professor Veca. Come insegnante, considero in modo positivo che il grande scienziato e il grande umanista, cioè il destinatario del premio, consegnino il testimone all’allievo o al ricercatore in modo che possano continuare gli studi e le ricerche del maestro o ancora meglio, le loro proprie ricerche. In questo modo, il passato e il futuro si incontrano. La Fondazione è come una scala, serve per facilitare le conoscenze di ieri verso quelle di domani. Questa è la notevole testimonianza dell’impegno di promozione e incoraggiamento delle scienze e della cultura della Fondazione Balzan.

Vorrei concludere esprimendo calorosa gratitudine al Presidente della Fondazione, Professor Enrico Decleva, al Presidente del Comitato Generale Premi Balzan, Salvatore Veca, e ad Alberto Quadrio Curzio, Vicepresidente del Consiglio della Fondazione Internazionale Balzan “Premio” di Milano, al quale rivolgo il più affettuoso ringraziamento per aver contribuito a consolidare e a rafforzare la fattiva collaborazione tra la Fondazione Balzan e l’Accademia dei Lincei.
Opening Address

Salvatore Veca, Chairman of the General Prize Committee, International Balzan Foundation “Prize”; Professor of Political Philosophy at the Institute for Advanced Study (IUSS), Pavia

Thank you very much, Professor Maffei, for your opening remarks and for your generous observations and comments on our Balzan Foundation.

Good afternoon ladies and gentlemen, and dear colleagues. On behalf of the Balzan General Prize Committee, I welcome you to the 2014 Balzan Prizewinners’ Interdisciplinary Forum. I wish to express my heartfelt congratulations to Ian Hacking, Dennis Sullivan, David Tilman and Mario Torelli. I would also like to thank the Accademia Nazionale dei Lincei for again hosting our Interdisciplinary Forum, which has become a regular fixture in the programme of events surrounding the Balzan Awards Ceremony, and – I might add – a much-awaited one, with many participants, as we saw this morning – a fantastic morning – with the presentations of young researchers committed to the Balzan Research Projects, and with the presentation and illustration of Vivre en Famille, this year’s winner of the Prize for Humanity, Peace and Fraternity among Peoples.

As President Maffei said, the Forum is made possible through a partnership between the Balzan Foundation, the Accademia Nazionale dei Lincei and the Swiss Academies of Arts and Sciences, which hosts it when the Balzan Awards Ceremony is held in Berne. I would like to take this opportunity to thank the one who initiated this collaboration, Professor Alberto Quadrio Curzio, whom you will hear from shortly when he chairs the first session, and to express my conviction that this partnership will continue to flourish, bolstering the solid, long-standing relationship between Italy and Switzerland that characterizes the Balzan Foundation and its commitment to interdisciplinary and international dialogue.

Today’s Forum deals with the topic of academies and patronage to promote excellent and independent research, and the keynote speech will be delivered by Professor Günter Stock of ALLEA (All European Academies), whom I would like to welcome and thank for agreeing to be here today.

At this time I kindly ask Professor Alberto Quadrio Curzio, who not only has important responsibilities in the Accademia dei Lincei and in the Balzan Foundation, but is also a good friend for us, to come to the podium as moderator of the first session to make some opening remarks and to introduce Professor Günter Stock.
Comment on the Italian Presidency Semester of the Council of the European Union and Presentation of Keynote Speaker

Alberto Quadrio Curzio, Chairman of the Joint Commission (International Balzan Foundation “Prize” - Accademia Nazionale dei Lincei - Swiss Academies of Arts and Sciences); President of the Class of Moral, Historical and Philological Sciences of the Accademia Nazionale dei Lincei, Vice President of the Board of the International Balzan Foundation “Prize”

Before starting the first session, I wish to ask you all, following an old tradition of this academy, to stand and share a moment of silence in memory of the former President of the Balzan Foundation, Ambassador Bruno Bottai, who recently passed away. I say this also on behalf of Professor Decleva, Professor Veca and President Casanova. So please stand.

In my capacity as Chairman of the Joint Commission of the Balzan Foundation, the Accademia Nazionale dei Lincei and the Swiss Academies of Arts and Sciences, I am very pleased to extend a warm welcome to all of you. The Accademia Nazionale dei Lincei is very happy to host the 2014 Interdisciplinary Forum of the Balzan Prize-winners under the portraits of Prince Federico Cesi, founder of this academy in 1603, and Galileo Galilei, scientist par excellence and fellow of the Lincei since 1611.

This year our ceremony falls during the Italian Presidency of the Council of the European Union. We have high hopes that this Italian Presidency will be able to strengthen the European Union in the eyes of its citizens and address the difficult challenges that Europe is currently facing, especially for youth unemployment. These challenges were in fact recently discussed at a conference on the future of Europe, on European constitutions and on the state of the Union, organized by the Accademia Nazionale dei Lincei at the beginning of this month. The conference was honoured by the presence of outstanding European political and academic leaders, and the keynote speech was delivered by Hermann Van Rompuy, outgoing President of the European Council.

Although the conference did not go into the role of science in Europe, the key role of science in sustaining policy-making at the European level is certainly acknowledged. Today here, we recognize the Balzan Foundation for its important contribution to promote science and culture and to celebrate the remarkable achievements of the Balzan Prizewinners.
I am very pleased that this Forum will be opened by a keynote lecture by a firm supporter of scientific knowledge and the role of academies in Europe and worldwide to uphold the sciences. Indeed, I am very honoured and also quite happy to introduce Professor Günter Stock, President of ALLEA, the European federation of national academies of science and the humanities, and President of the Berlin-Brandenburg Academy of Sciences and Humanities. I will not go into details of Günter’s impressive scientific accomplishments, but I will limit myself to stating that since his appointment as President of ALLEA in 2012, in the general assembly which incidentally was held at the Lincei, Professor Stock has done an exceptional job in enhancing ALLEA’s mission.

With Professor Stock’s visionary and concrete leadership, ALLEA has grown in strength and intensified its contacts in the framework of the relationship between the European Union and the European scientific communities. Today ALLEA, through its sixty member academies in more than forty countries, plays a fundamental role in addressing policy issues in science, research and innovation, as well as offering advice to society and the decision-makers in Europe. This is done through the activities of the permanent working group on science and ethics, on intellectual property rights, and the working group on science, education, social sciences and the humanities.

Professor Stock is also involved in collaborative efforts to establish a network of interactions between ALLEA and other organizations, such as EASAC, the European Academies Science Advisory Council, Euro-CASE, the European Council of Applied Sciences, Technologies and Engineering, in order to promote a united and fruitful dialogue with the European Commission on all these issues. Under Günter’s guidance, ALLEA has also become very active in promoting the European cultural heritage, especially with the establishment of the All European Academies Madame de Stäel Prize for Cultural Values. The ALLEA Prize was awarded for the first time this year to the Italian historian Luisa Passerini, and I feel honoured to be part of the prize jury.

With this brief introduction, I am very pleased to pass the floor to Günter Stock, who will deliver the keynote lecture “Academies and Foundations to Promote Excellent and Independent Research”, a topic which reflects his firm beliefs that scholars and academicians as representatives of scientific communities are able to provide high level and authoritative advice to public institutions and to decision-makers.

Günter, the floor to you.
Prestigious prizes like the Balzan Prize and public award ceremonies are a great opportunity for scientists, for the science system itself, for institutions, and in most cases for foundations to show and present their work. And there are several reasons why science, the science system, and scientists benefit from prizes.

First, prizes clearly show to the non-scientific world the necessity for and, even more so, the abundance of excellence. Second, within the science and research system, prizes send a clear signal that excellence counts and that the decisions of the jury are carefully observed by their peers, and hence they are part of the quality assurance practice within science. And finally, since the prizes of course are given to personalities but are surely not independent of the topic they have been working on, the decisions of the jury can also be a hint about trends in science.

For foundations, the awarding of prizes is a perfect opportunity to document their principles and demonstrate their missions. Moreover, it is a wonderful signal that civil society cares about our future and hence cares about science. And there is no doubt that science, the science system, and we scientists need the support of non-governmental foundations, support which of course goes far beyond donating funds for prizes.

In order to talk about the role of foundations and academies within the frame of our science and research system, we first need to begin with a few general remarks on science and our current system.

There is no doubt that the world we are living in is a so-called “Leonardo world”, a term created by Jürgen Mittelstraß, a German philosopher who indicates with these semantics that we scientists and engineers have largely contributed to what is surrounding us, I mean to our world as it is.

There is, again, no doubt that the challenge, the responsibility to further improve the conditio humana and hence to tackle all the challenges ahead of us, be it climate, be it energy, be it health, can only be tackled by science, by better science, and most
likely by more science. However, it must be science that is interconnected and truly problem-oriented, since the problems we are facing are not only disciplinary in nature. The great challenges do not care about disciplinary functions and borders. And one of the major challenges within science has been and is to grasp these complexities with interdisciplinary or, as Mittelstraß would put it, with transdisciplinary approaches.

Universal geniuses like the founder of my academy, Gottfried Wilhelm Leibniz, or Isaac Newton, founder of the Royal Society in London, or even Leonardo, are no longer available nor possible. Therefore, we have learned to organise science, especially but not only the field of big science, into consortia and in many cases regional and, where appropriate, supra-national or even globally acting teams. And yes, this has led to an interdisciplinary working attitude, which, however, in most cases is still an interdisciplinary philosophy within the natural sciences, including engineering.

Bridging the gap with the humanities and social sciences is still a major effort which we have to make since, as I mentioned before, most of the big challenges are still ahead of us. And the challenges need reflection, a true risk-benefit analysis which goes beyond technology and economics. Therefore, I would like to mark this true interdisciplinarity as the first of a number of “desiderata” we still have in science and within the science system. I think that is what Dr. Maffei meant in his introductory remarks.

There is no doubt that the way we have approached our problems in the past and today has been and still is highly successful; the scientific achievements in our various disciplines are breathtaking. This is true in my field, medicine, where we have begun to understand diseases at the molecular level and also treat them at this level. Another example of our enormous scientific success during the last decades is the field of space research, where scientists have managed to land a satellite called Philae after a 10-year journey on a small comet with the size of 12 square kilometres.

Of course, there are many more examples in all the fields we are dealing with. All of these achievements have a direct impact on our daily lives, but they also increase the expectations people have of science and the desires of those who, by profession, have to care about science – to be specific, not only scientists, but also politicians and managers.

The successes increase their desire for new solutions to tackle the challenges ahead of us, and of course decision-makers want to direct the money which is spent on research more and more towards those areas which promise new products, new processes and new solutions. This is what we call product-oriented or applied research.

It is less and less understood that there is a continuum between curiosity-driven research and applied research. Curiosity-driven research is the beginning and the humus of all. Without this type of research, the ensuing applied research will soon die
out. And it is also true that there is no clear sequential order between curiosity-driven and applied research. However, we know much better today that there is an interactive relationship between these two.

Some curiosity-driven research has an immediate impact on applied research, but sometimes it takes 15 or 20 years to obtain results in applied research as it for example happened in what we call biotechnology today. There, it took from the late forties and fifties to the eighties and nineties to create a new industry out of the early research efforts. Sometimes questions arising in applied research necessitate completely new approaches to thinking and experimenting, and sometimes one has to go back to very elementary and basic questions in order to overcome hurdles and solve applied research questions. This even has consequences in the organisation of science and in our innovation system. University research, which used to be curiosity-driven research, today sees the new necessity of looking into applied research as well. And industry, the classic locus for applied research, in many cases faces an enormous need for curiosity-driven research in house, often with the help of networks including academia.

So, the relationship between invention and innovation, with innovation being the practical outcome of what has been created before as invention, is highly complex. And there can be no innovation without invention, because in most cases breakthroughs are made in curiosity-driven research. So I would like to state that my second desideratum is the need for curiosity-driven research, which must not be scaled down – in contrast, we need more and more of this kind of research.

In this context, we have to learn a third lesson: research in the humanities and in the social sciences is not only needed to preserve our cultural heritage. It is not only needed to interpret this heritage and make it available for our current thinking. It is also needed because, in the words of the German philosopher Hans-Georg Gadamer, “Zukunft braucht Herkunft”, or if you would like to put it in English: “If you want to prepare for the future, you need to know where you come from”.

The hype about news in natural science or engineering and the excitement which it creates should never lead us to negate this basic principle – the need to support research in the humanities and the social sciences. And, nevertheless, it took more than two years to make the Commission in Brussels that elaborated Horizon 2020, the new framework programme for research in Europe, understand that the humanities and social sciences are not only helpers and, to put it negatively, “reflection machines” of the developments of the natural and technical sciences, because these fields have their own research needs in basic, curiosity-driven research.

We know of many countries – and not only the poorer ones – that are cutting expenses for the humanities and social sciences. And this is done in times when, more than ever, we
need true interdisciplinarity, which means that not only mathematicians, engineers and material scientists work together but also philosophers, sociologists, and other researchers.

The big challenges ahead of us demand and need the work of the social sciences and humanities, disciplines that take part in the dialogue on the best possible way towards the future and, from the beginning, add their competencies to the large transformation processes which are a characteristic of our time.

The old traditions which are sometimes pursued to find technical solutions and then, sometime later, even years later, used to reflect on consequences for our societies, represent an attitude and sequence which no longer work. Large technical programmes need intensive parallel reflections with ethics, philosophy, law, sociology and other disciplines. And of course there are more massive transformation processes ongoing in our societies, such as migration, religious diversity and many others which need new research and new concepts.

So my next topic in my list of desiderata is the preservation of the roots of innovation: curiosity-driven research including the humanities and social sciences. And this new development within science is paralleled by new ways of communication. Within science we now have a massive movement called “open access” in which the role of publishers and science journals is questioned or threatened, or as you can also say in a positive way, supplemented by pre-publications and publications on the internet and in social media with blogs and tweets, which are used to distribute scientific results, or I should rather say bits and pieces of scientific results.

Especially social media are used to increase the awareness for scientific results, and Wikipedia, with its enormous amounts of data and information and sometimes even scientific knowledge, gives all of us the impression not only of rapid and easy access to what the world knows, but almost kindles the feeling that the availability of scientific data is identical to a solid knowledge of and the ability to properly reflect and interpret the data and bring them into context. But this is by no means sufficient for enabling and improving judgement!

A couple of years ago, we had a very simple communication system: the scientists on the one side published their data and their interpretations in peer reviewed journals and if the data were of some interest to the public, science writers in journals on the other side were there to translate it to the public. Only rarely did scientists directly address the public; this attitude was even judged as being non-scientific and the scientists were regarded as being not as serious as they should be. Only the most successful were somehow appreciated by their peers.

Things have changed completely. On top of this and as a consequence, data linked to science, be it positive or negative, are in most cases not reported by science writers.
but are first reported by general journalists. And the first reports, as we know, set in most cases the tone and the trend as to how the topic would be discussed in the media from that point onwards. When science writers and scientists, especially in cases where negative events are reported, start to discuss and to reflect on what has happened, the first hype has faded and the interest of the general public has already turned to the next topic. So the next challenge we are facing is to prepare our scientists for this new world of communication, be it scientific communication or be it communication with the general public.

And there are many other challenges for scientists and the science system which should be discussed, but I myself will concentrate now on my last and final point, and this is the education of our young generation. It is general knowledge but not yet on the political agenda that the number of young people who are studying natural sciences – in Germany we call it MINT (mathematics, informatics, natural sciences and technology), which is called STEM in the Anglo-Saxon world, standing for science, technology, engineering and mathematics – is getting smaller and smaller. This is true for many countries in which almost half of the young generation is entering university today.

The desperate need of our science-based society for trained and educated young people, especially in the fields of MINT or STEM, has now become an important economic factor. And in this situation, scientists as well as scientific organisations have to think and act carefully in order to find ways to increase the desire of young people to go into these fields and stay there, especially in engineering, where a high amount of beginners, after some time, leave their studies and do something else. Thus, motivating and retaining these talents is an important aspect we have to deal with. At the same time, we also need a fresh look at how to improve the skills of students in the fields of humanities and social sciences. Here, I feel, a major issue is not the number of students but rather their attitudes, their preparedness to cope with the new challenges in their disciplines.

Ladies and gentlemen, I think with this array of needs and future needs I have now somewhat prepared the floor for the discussion on what academies and foundations can contribute within the focus I have chosen. As president of ALLEA, I ask for your understanding that I first start with academies and the role they can and should play in the context I have discussed.

Academies, if I start with the old Greek academies of the Platonic type in the 4th century before Christ, were places where the independent and undistorted search for the truth could take place. They were places where individuals could follow this mission in a secure and trusted environment. This idea and principle was somehow forgot-
ten until the times of the Renaissance and Enlightenment at the beginning of the 18th century, when this idea was rejuvenated. The Lincei Academy that was founded in 1603, the Leopoldina, Germany’s National Academy which today is located in Halle, the Royal Society in London, and the Académie des sciences in Paris were the first modern academies created in Europe where scientists, independent from courts, could perform independent research. However, these academies only brought together the natural sciences and medicine. Gottfried Wilhelm Leibniz in fact was the first who felt that in order to improve the conditio humana, one needs all sciences which should work together in order to combine theoria cum praxi.

Leibniz did not place one discipline above the other, he wanted to have this combination and he already knew that careful deliberation is part of our scientific duties before and during implementation of new ideas. A mission, ladies and gentlemen, that could not be better formulated in today’s world. Our host, the Lincei Academy, is in the same league. Academies and foundations have the autonomy to act and the preservation of this autonomy in common.

The autonomy of research and science is one of the great contributions that have altered and modernised the science system. Whilst the academies provide a space where scientists can retreat and reflect on what they are doing, what they should be doing, and where they can learn and train interdisciplinarily, learn to understand the language being used in disciplines outside their own, and learn to understand and appreciate approaches being taken in other disciplines, foundations can, in a complementary way, also support scientists by offering them opportunities to retreat and to reflect in an interdisciplinary manner. And both academies and foundations can define new topics which can be dealt with by the scientists – topics which can be identified in workshops or congresses with a different level of publicity and also without publicity. This is a fantastic opportunity that foundations and academies can offer to scientists: the opportunity to retreat and reflect. In many cases, this is also an opportunity for interdisciplinary work as the basis for what we call “scientific advice”, both for the public and policy. The ability to take the different steps from information to knowledge and from knowledge to judgement is an opportunity often offered by academies and foundations in a similar way – an asset that is probably more important than ever.

Discussions in many foundations, but especially in the academies which are for example brought together in ALLEA, were instrumental in shaping Horizon 2020 in Brussels, especially in creating a new awareness for curiosity-driven research, interdisciplinarity and offering a raison d’être for giving the humanities and social sciences a special chapter within Horizon 2020, which was, as I mentioned before, heavily debated for a long time and as we all know is not over yet.
The technocrats in Brussels, as I will call them, are still trying to minimise and sometimes trivialise the contributions of the humanities and social sciences towards coping with the challenges ahead of us and ahead of Europe. Without the help of foundations or private donors, and as we have learned this is also true of our American colleagues, curiosity-driven research, especially in the humanities, would not be possible.

If I look at the work by my Academy in Berlin, the edition of Friedrich Nietzsche and the new editions of Immanuel Kant or Gottfried Wilhelm Leibniz would not be feasible without the generous donations of foundations – luckily, supplementary in my country to what the government is doing in an exceptional way.

How do we create new ideas and new initiatives in our sometimes rigid academic system and how do we bring in new ideas and help to make them part of the institution? In many cases, think tanks in academies and foundations can formulate new needs, and the advantage of foundations is that they can financially support and also sponsor or endow chair programmes. All this can be and is being achieved by foundations.

There is one minor concern, however, that I would like to raise: sometimes I feel that in recent times foundations have started to formulate their own programmes more and more, and support only topics which fit into these programmes which, by nature, might be even narrower than their missions. And I would plead that foundations remain open to applications by scientists who are trying to pursue ideas that are clearly both far away from the mainstream and risky.

Yes, I do appreciate that foundations already take more risks when funding as compared to governmental funding agencies, but this is exactly what I am asking for: maintaining this attitude towards sponsoring non-mainstream and therefore uncertain projects. This is where the scientific adventure is and where the borders of current knowledge are. And in the words of Francis Bacon, that means: “As the birth of living creatures at first are ill-shapen, so are all innovations”. This is where foundations can have the highest impact, not by filling gaps left by governmental systems but rather where we open up a new world, where science is, at its core, questioning existing knowledge, widening the horizon, crossing borders of disciplines and knowledge and truly exploring a completely new approach and perspective. This is where transdisciplinarity can start and where scientists have the energy and the courage to make themselves vulnerable by leaving the disciplinary safe harbours.

Training our young scientists as scholars in what we call “soft skills” is not part of the classic government-sponsored curricula. Here again, academies and foundations play a prime role in enabling both our young and seasoned scientists to cope e.g. with the new challenges within the communications system.
As we all know, in modern societies scientists have to defend why and what they are doing more and more, and normally they are not trained in this field. Therefore, enabling our scientists to fulfil the different jobs a scientist has to be skilled at is a wonderful area where we as academies and foundations can truly help. And, actually, the extent to which this is already being done is amazing. Best practice examples are available!

What we have not managed so far is how to “train” the public to listen to scientists carefully and also prepare them to follow more complex sequences of thought. How can we teach the public not to stop at a certain level of information, but to try to accompany scientists on the complicated journey towards knowledge and judgement?

Again, this is a badly needed field of activities for academies and foundations. Here they can join forces and work towards creating new procedures for public deliberation. This is one of the pressing necessities if we want to bridge the gap between what science knows and needs to do and what the public understands and wants and needs to judge.

Finally and again, I think foundations and academies were the first to analyse and react to the need for increasing the awareness and preparedness of young people to study MINT and STEM subjects. A lot of initiatives have been taken that are already starting with young children in kindergarten and continuing in primary school, where, as I see it, the main need is not to reawaken interest in natural sciences but to try to maintain and kindle the curiosity that is already there. There are effective programmes at the ages when secondary education takes place, but what we lack are programmes to train the trainers, meaning: to teach the teachers. We have to direct more awareness towards enabling the teachers, who, in many countries, or I would say in most countries, are left alone to do their training individually. We need systematic programmes to modernise their knowledge, their teaching practices and, in some cases, their motivations as well. The burden teachers are carrying in today’s schools is largely underestimated and definitely underpaid.

And if this is true in rich countries, it is an even more difficult situation in poor countries, especially in Africa – a continent which is now coming more and more into our focus, where we need to carefully consider providing help if we want to stop the exodus of educated citizens from those countries. And here the Lincei Academy which is hosting us today is already at the forefront of designing programmes, and we all hope that Europe is wise enough to support these activities, because what we can achieve with these programmes directed and invented by scientists is economically inexpensive when compared to the costs which are created if we do not react.

Early reaction, prevention, and signalling where new needs are identified, bringing them to public awareness, and providing some funds for those new ideas – this is
where academies and foundations join in. But foundations, due to their financial re-
sources, can play an admirable role in implementing ideas and bringing concepts to 

fruition.

Finally, I believe that joining forces between academies and foundations is an asset 
which can and should be exploited more. We can all learn from the cooperation of the 
Balzan Foundation and the Lincei Academy.

Thank you, ladies and gentlemen, for your patience. Thank you for inviting me, 
and congratulations to the winners of the prestigious Balzan Prizes. Thank you.
Session I

Alberto Quadrio Curzio

Many thanks indeed, Professor Stock, for your thoughtful analysis of the current situation and for the fundamental indication of the lines along which academies and foundations should move more and more. I have to say that when I met Professor Stock, I was really impressed since the beginning by his attention to the humanities, which seemed to me rather surprising for a professor who mainly does experimental research. And I have to say that he has done a wonderful job convincing, with quite a lot of time and effort, the European Commission and the technocrats that the humanities are important for any kind of research.

While he was talking about the editions of Kant, Leibniz and Nietzsche, I was thinking about Galileio and Cesi, who connected fundamental ideas about knowledge and research to the freedom of philosophy and the freedom of experiment. For them, these two sides of the human learning process were never disconnected. So many thanks indeed for making these specific points.

Quite appropriately, as far as I can judge, you mentioned the necessity of going outside the mainstream in order to drive innovation, which academies and foundations must support in very different ways. And you also made another very important point, which is the core, or better, which is one of the cores of our Lincei Academy, which is education. Professor Maffei has done enormous work for education all over Italy, setting up “poles” for young people.

I hope – and I have already said this on many other occasions – that you will be President of ALLEA for twenty more years. Since now, Günter, I don’t really know if you are set up to be President of ALLEA for the next twenty, but in any event, you’ll be responsible for the next president, so you won’t have an easy job. If the Balzan Foundation, the Accademia dei Lincei and you agree, we will send your speech to the outgoing president of the European Council, Van Rompuy, with whom I discussed these problems, and to the incoming president Tusk, and I think to the president of the European Parliament, Schulz, as well. And finally, of course, to the Italian President, the Italian Prime Minister Renzi, to bear witness to the Italian Presidency’s contribution to the semester of the European Union.

Now we will go on with our Interdisciplinary Prizewinners Forum. So the floor goes to Professor Salvatore Veca, Chairman of the General Prize Committee, who will present the Prizewinner Ian Hacking, for Epistemology.
Presentazione di Ian Hacking, Premio Balzan 2014 per l’epistemologia e la filosofia della mente

Salvatore Veca

Professore emerito dell’Università di Toronto e professore onorario al Collège de France, Ian Hacking è uno fra i più autorevoli filosofi contemporanei delle scienze formali, naturali e sociali, impegnato in una ricostruzione e un’interpretazione genealogica di importanti teorie, concetti e categorie scientifici. Il motivo conduttore delle ricerche di Hacking è costituito dalla ricostruzione dell’analisi, delle circostanze, culturali, sociali, istituzionali, cognitive e pratiche, in cui possiamo individuare l’insorgenza o l’emergenza storica di modi di vedere le cose, di stili di ragionamento o di teorie su noi o sul mondo che modellano i nostri orientamenti contemporanei nell’ambito della conoscenza scientifica.


La migliore filosofia della scienza del secolo scorso ha perseguito il sogno del metodo, sia nella visione induttivistica e verificazionistica del Rudy Carnap, sia nella visione deduttivistica e falsificazionistica del Karl Raimund Popper. Hacking dimostra
che l’immagine predominante della scienza nella filosofia della scienza predominante è fallace e che l’analisi filosofica delle teorie scientifiche deve mettersi alla prova con le pratiche scientifiche. E questo ci chiede di prendere sul serio, al tempo stesso, tanto le rappresentazioni del mondo quanto i nostri modi di intervenire nel mondo attraverso esperimenti. La prospettiva di Ian Hacking sui nostri mutevoli e plurali modi di costruire, rappresentare, classificare e interpretare noi stessi e il mondo è illuminante, e accompagnerà a lungo le ricerche filosofiche sulla storia e i mutamenti della conoscenza scientifica.

Vorrei ringraziare qui di nuovo Rachel Hacking, che ieri ha ricevuto il premio e che ha letto con attenzione il testo di accettazione di Ian Hacking. And I will thank very much Professor Pickavé of Toronto University for helping me to illustrate not only the structure of the research by Hacking, but also the programmes of research. This programme of research centred on the idea of styles of reasoning in different areas is a Balzan Research Project, and we are proud of this outcome of our choice.
Ian Hacking’s Styles of Reasoning

Martin Pickavé, Chair of the Department of Philosophy, University of Toronto

It is an honor to say a couple of words about my colleague Ian Hacking’s research and his Balzan Prize research project. Since many of you are probably not familiar with Ian Hacking’s large body of publications, I will first give a short overview – complementary to what we have just heard – of some of the main axes of his research so that it will become clear how the project relates to this body of work. But before I begin I would like to point out what a wonderful coincidence it was that Ian Hacking was awarded the Balzan Prize yesterday, on UNESCO World Philosophy Day!

As he said himself in the acceptance speech, read by his daughter Rachel Gee, Ian Hacking’s work is best understood as an exploration of foundational issues in both epistemology and the philosophy of mind, as an exploration that is remarkably different from the way in which these philosophical disciplines are conducted nowadays, at least in the context of current Anglo-American philosophy. What do I mean by that?

Let’s turn first to epistemology, which is still very much exercised as an inquiry into the nature of knowledge. Questions such as “What is knowledge?” – whether it is something primitive or whether it is analyzable in terms of something more basic, for instance, justified true belief – and the conditions of the possibility of knowledge lurk still large in contemporary epistemology. Yet in contrast with these rather abstract topics, Ian Hacking’s central contributions to epistemology have instead been devoted to the structure, role, and influence of statistical and probabilistic reasoning and in the philosophy of experimental science. So he has a rather more pragmatic approach than most of his fellow philosophers in epistemology.

Much of his early work, notably his Logic of Statistical Inference (1965), was concerned with the formal structures of statistical and probabilistic reasoning. But fairly quickly Ian Hacking expanded his approach by beginning to look at the historical roots of such reasoning. Taking inspiration from the French historian and philosopher Michel Foucault, he explored the emergence of a new kind of epistemological agent who was able to see the world in probabilistic terms. In his influential and recently reissued book The Emergence of Probability (originally published in 1975), Ian Hacking examines the early days of probability in the seventeenth century, when the Renaissance doctrine of signs and “signatures” mutated as gamblers tried to improve their profits. The new notion of probability was quickly applied to such disparate topics as law, annuities, literature, and the causes of death. This book also inaugurated the
modern historical study of probability, a topic that has now become the focus of a large and active research community.

Ian Hacking continued this line of research in a later book, *The Taming of Chance* (1990), in which he investigates, again focusing on a specific period, what he calls the “avalanche of printed numbers” at the end of the Napoleonic Wars in the early nineteenth century. This work stands out not only for his philosophical insights, but also for the author’s wide-ranging and erudite reading of the literature of the period on crime, suicide, sociology, medicine, historiography and debates about free will. Ian Hacking demonstrates how chance became law-like and, in its journey from the margins to the mainstream, changed society. *The Taming of Chance* was included in the Modern Library List of the 100 most important non-fiction books written in English in the twentieth century, placing Ian Hacking alongside a very select list of transformative public philosophers including Isaiah Berlin, John Dewey, William James, Thomas Kuhn, G.E. Moore, Karl Popper and John Rawls.

Ian Hacking’s most recent book on this topic, *Probability and Inductive Logic* (2001), stems from his many years of teaching large undergraduate lecture courses. Now students throughout the world have the opportunity to benefit as the leading expert on the history and philosophy of statistical reasoning helps them understand the statistical “noise” that surrounds us in everyday life.

The philosophy of experimental science is another subfield of his interest in epistemological issues. Traditionally, most philosophers of science tended to abstract from the actual practices of scientists. Ian Hacking was one of the first to challenge this philosophical insulation from the “real world”. In a series of classic articles, culminating in his *Representing and Intervening* (1993), he shows that for philosophers to make progress in their understanding of science they have to investigate what scientists actually do. This includes studying how they construct experiments to produce and manipulate phenomena. Ian Hacking’s discussion – with its pithy slogan, “if you can spray them, they are real” (referring to unobservable entities such as electrons) – also reinvigorated and refocused the debate over whether human knowledge can access the deep structures of reality. He wrote this work, which has – as many other of his books – been translated in many languages, while teaching at Stanford, talking to his colleagues in the natural science labs, and conveys a deep curiosity concerning actual scientific practices.

Ian Hacking’s approach to his second main area of research, philosophy of mind, is similar to that in epistemology. Again, he is less interested in the traditional problems of the philosophy of mind, such as the problem of consciousness, the mind-body problem, the nature of intentionality, perception etc. His work in this area focuses on the nature and development of concepts about the mind and their implications for hu-
man kinds. Beginning with his much-cited classic article “Making Up People” (1986), he has engaged in a micro-historical study of specific cases where the human sciences helped to create new kinds of people.

The major expression of this method is his *Rewriting the Soul: Multiple Personality and the Sciences of Memory* (1995), in which he examines how multiple personality disorders emerged out of a disparate set of diagnoses over the course of two centuries. By embedding the history of psychology in a rich cultural framework, he shows how people came to think of themselves in ways that eventually allowed them to be diagnosed as having multiple personality disorder. And he developed and continued this approach also in more recent books like, for example, *Mad Travellers: Reflections on the Reality of Transient Mental Illnesses* (1998), in which he looks at a particular epidemic at the beginning of the twentieth century, in which people would, in a daze, walk endless distances with little recollection of where they were and what they had done. Ian Hacking illuminates this phenomenon with a general theory of the social conditions, fables, urban myths, and professed knowledge that made the epidemic possible. These two unusual books on the philosophy of mind put him at the center of widespread discussions in the social sciences and humanities about the very idea of a “social construction”.

This is just to mention the research activities relevant to the areas for which Ian Hacking was awarded the Balzan Prize yesterday. If you were to press me to give a short summary of his general approach to philosophy, I would respond that his approach is best understood against the background of the classic distinction between theoretical philosophy, i.e., the part of philosophy concerned with the structure of reality and the nature of thought, and practical philosophy concerned with questions about value and how to live. Ian Hacking’s work and approach bridges this divide, investigating the ways in which the concepts through which we classify ourselves and other beings in the world shape our lives and interactions. The key idea is here that we, as human beings, are not just passively reacting to the world in which we live, but actively intervene in it and shape it. We create not just values, but also facts. One result of this approach is that, according to Hacking, there is less general opposition between the natural sciences, on the one hand, and the humanities and the arts, on the other, than people normally assume. Although these different forms of engagements in the world obviously rely on different styles of reasoning, they have a common root, which brings me to the second part of my remarks, namely, to the Balzan Prize project *Styles of Reasoning*.

One way to look at our interactions with the world is by asking questions like this one (and here I quote from a recent article by Ian Hacking): “How did a species like ours, on an Earth like this, develop a few quite general strategies for finding out about,
and altering, its world?" In pursuit of this kind of question, Hacking explores in fascinating detail how, as the new styles of reasoning emerged historically, as our conceptions of reality changed, the world we know took on new forms.

Before his current illness, Ian Hacking was working on the completion of a manuscript for a book entitled *Styles of Scientific Thinking: Truthfulness and Reason*. The immediate background of this book are lectures he gave during the Spring term of 2008, when he was the Peggy Downes Baskin Professor of Interdisciplinary Studies at the University of California, Santa Cruz. But actually, his interest in styles of reasoning goes back further. As he writes himself, he first became interested in this topic in 1978, here in Italy, when he heard the famous historian of science Alistair Cameron Crombie lecture in Pisa about this subject. (Towards the end of his life, Crombie published the fruits of his own research on styles of reasoning, his three-volume work of 1994, *Styles of Scientific Thinking in the European Tradition*.)

You may wonder, “What are these styles of reasoning?” Ian Hacking, with Crombie, acknowledges six major styles of reasoning, at least in the sciences. These include statistical reasoning, reasoning by analogy, deployment of experiments, ordering by comparing and taxonomy, historical derivation by genetic development, and the like. These are examples of existing styles of reasoning. But he also acknowledges that there are styles of reasoning that have gone out of fashion and thus out of existence, for instance, reasoning by means of similitude, which he takes to be characteristic of medieval and Renaissance medicine.

Two things are important to note about styles of reasoning. First, styles of reasoning are not the same as logic; as Ian Hacking writes himself in his characteristic, pithy manner: “Styles of reasoning create the possibility for truth and falsehood. Logic merely preserves it.” And second, with styles of reasoning come a great many other things, most importantly, the objects of inquiry and the evidence or the things, which count as evidence in an inquiry. Insofar as styles of reasoning are means by which we acquire knowledge about us and the world, Ian Hacking’s project can be seen as a historicized reinvestigation of Immanuel Kant’s classic topic, namely, the conditions of possibility for knowledge.

Now, let me come to the practical side. What will happen at the University of Toronto in the context of this research project on styles of reasoning? The research project will allow young, emerging doctoral students to continue to explore styles of reasoning in the wide range of topics dealt with by Professor Hacking himself, namely, medicine, psychiatry, sociology, philosophy of mind, epistemology, philosophy of science, philosophical psychology, statistical inference, philosophy of mathematics and logic, ethics, philosophy of language, and history. Toronto has one of the largest
graduate programs in philosophy in the English-speaking world; and the Department of Philosophy has close ties with the University’s Institute for the History and Philosophy of Science and Technology, to which Ian Hacking is also closely connected. All this is to say that there is a crucial mass in Toronto of talented young scholars working on the intersection of philosophy of science and the particular sciences themselves. The Balzan Prize will enable us to establish a research group, directed primarily by Professor Cheryl Misak, who will figure as the deputy supervisor of the project. Members of this group will be funded for pursuing a specific subproject of *Styles of Reasoning*. The exchange with European universities, with many of which Ian Hacking has close contacts, has always been very dear to Ian Hacking. This is one of the reasons he suggested that some of the funds should be dedicated to visiting graduate students from European universities, so that they too can participate in the activities of the research group. The final results of this project will be presented at a conference in Toronto at the end of the funding period.

**Comments from the Chair**

*Alberto Quadrio Curzio*

Thank you Professor Pickavé for your brilliant presentation on both the results of Professor Hacking’s research and the project for future research, which demonstrate the fruitful work of our General Prize Committee. This year’s Balzan Prize in epistemology marks the progress in the field over the years. Moreover, the decision to divide the prize into two parts, that is, one part to the prizewinner and the other part devoted to young scholars, is truly fundamental. Thus, in my capacity as President of the Class of Moral Science of the Lincei, many thanks to the Balzan Foundation for having taken this decision long ago.

Now the Prizewinner in mathematics, Dennis Sullivan, will be presented by Étienne Ghys, a member of the General Prize Committee, a brilliant mathematician capable of arousing anyone’s interest in his subject – even non-mathematicians. So, the floor to you, Étienne.
Dennis Sullivan is one of the best topologists in the world. In his lecture, he will discuss the topology of fluids. Topology is traditionally part of pure mathematics, and the study of fluids is usually considered a part of applied mathematics. Is it possible to be both pure and applied? Today, I would like to give you a historical example where topology and fluids were already in contact – where the pure and applied aspects had already merged. However, this example was a complete failure. For fluids, it turned out to be useless, but for topology it was very useful.

What is topology? Topology is about space. What is space? We could discuss this question for days and days, and hours and hours, but I only have ten minutes. Let me start by saying just a few words about the scientific and philosophical situation at the end of the seventeenth century. There was a great controversy – the French against the English, of course, Descartes against Newton. According to Newton, space was empty; it was a container of particles. This empty space was indeed empty, but not quite empty; it was sensible to God. It was a sensorium dei, the medium through which God was in connection with us. In the case of Descartes, there was no empty space. Space was identical to matter; it was a sort of fluid flowing in structures that he called vortices. Space was just a huge quantity of vortices rotating around us. Both of these traditions have been very successful. In a certain sense, one could say that Descartes is at the origin of the modern concept in general relativity, where matter and space are identical.

By the beginning of the eighteenth century, Voltaire wrote a concise description of this situation. I wanted to translate it into English, but translating Voltaire into English is sacrilège, so I will quote him in French. In his wonderful set of letters entitled Les lettres anglaises, Voltaire says:

Un français qui arrive à Londres trouve les choses bien changées en philosophie comme dans tout le reste. Il a laissé le monde plein ; il le trouve vide. À Paris, on voit l’univers composé de tourbillons de matière subtile ; à Londres, on ne trouve rien de cela. […] Chez vos cartésiens, tout se fait par une impulsion qu’on ne comprend guère ; chez M. Newton, c’est par une attraction dont on ne connaît pas mieux la cause.
To move ahead a few years, the beginning of the mathematical theory of fluids starts with Euler in 1740, with his paper called *Principia motus fluidorum*, where he wrote the equations for the motion of fluids. Two years later, Frederick II the Great sent a letter to Voltaire. This letter is in German, but since I do not mind translating German, here is what he said (in English): “I wanted a fountain installed in my garden. Euler calculated the force needed for delivering the water to the tap. My mill was constructed geometrically, but does not allow a single drop of water to go further than five steps. Vanity of vanities; vanity of geometry.”

Continuing with our chronological account, in 1857 Helmholtz wrote a wonderful paper where he proved a theorem in a very abstract manner. He proved that what we call vorticity is preserved during the motion of a perfect fluid. He proved that if the flow of the fluid contains some kind of vortex somewhere, this vortex will survive forever. Ten years later, the Scottish physicist Tait was impressed by this paper, and he wanted to see it with his own eyes. So he constructed a very strange cannon, which would fire smoke rings instead of bullets. It was built like a box full of smoke, and when tapped on the back, beautiful rings of smoke came out. It is fascinating. Any attempt to cut the rings with a knife would yield no result, because the apparatus was very stable. The great Scottish physicist Kelvin was so amazed by it that he immediately created a theory of vortex atoms.

At that time, modern atomic theory had not yet been formulated. Mendeleev’s periodic table was not available; nobody knew exactly what an atom was. There were basically two theories. The first presented atoms as perfect balls, in a Newtonian way. They had infinite elasticity, like billiard balls. The second compared them to waves in a medium, which would be the ether. Kelvin’s theory stated that an atom is nothing more than a vortex ring in space travelling around us. Kelvin said to his friend Tait, “You should get the complete list of all possibilities of creating knots. Each knot will be associated with a chemical element. There will be a knot for sodium; there will be a knot for oxygen, there will be a knot for carbon... If you give me the list of all possible knots, we will try to put that in correspondence with the list of all possible chemical elements.” Thus Tait began, working hard until he produced the first non-trivial work on knot theory, which is one of the major chapters in contemporary topology.

Today, Kelvin’s theory on vortex knots is completely useless. At the end of his life, in fact, even Kelvin himself recognized that it was a bad idea, and that he had been completely wrong. Nevertheless, Tait’s work in topology was so deep that he was able to obtain beautiful tables analogous to Mendeleev’s – tables of knots up to ten crossings with no mistakes. Today, with the powerful tools in topology available to us, we
have been able to check his work, and have seen that he made no mistakes. Thus I believe that this is an example where topology had already met fluids in some strange way. It was a failure for fluids, but a success for topology.

Dennis will now discuss an approach to fluids from topology. I hope this time it will be a success for fluids.
Computing Three-Dimensional Fluid Motion

I am going to use one small piece of mathematics that some of you may remember from secondary school, the “quadratic equation”. You have an equation, “a” times “x squared” plus “b” times “x” plus “c” equals zero. You can solve it with the nice quadratic formula which evolved over the millennia and flourished and was extended to cubic equations in Renaissance Italy, with Pacioli, del Ferro, Tartaglia and Cardano in the 1500s.

Fluids are described by a more complicated quadratic equation, but there is some similarity in form, so let me discuss the simpler equation. When you solve this quadratic equation, there is a good region and a bad region. We insist on real number solutions in our analogy, since fluids are real. We cannot use imaginary numbers directly to describe fluids; we have to use real numbers.

In the good region, there would typically be two real numbers that solve our quadratic equation. In the bad region there are no real solutions. Let’s imagine that our equation depends on time. For example, one or more of the coefficients a, b or c of the pieces in the equation depend on time, and let us assume that we start off in the good region. Then these two real numbers are moving around as time varies. What happens? They could actually move around and then come close together, touch each other and bounce off, and everything would be fine. Or they could come together, and – poof! – disappear. The quadratic equation has passed into the bad region.

You may also recall from school that there is a certain combination of the elements in the equation that can keep you safely in the good region. One knows if the time evolution keeps the quantity “b squared minus four times the product of a and c” from becoming negative, then one stays in the good region with real solutions. If only we had such a discrimination in the more complicated quadratic fluid equation, we could know when and why the mathematical fluid solutions would exist for all time.

Now I would like to tell you how I came to work on the fluid problem in the early 1990s and to present some of the ideas that have emerged since then. All of this has led up to the Balzan project, which will combine these elements.

Serious mathematics for me started by studying topology, even though before that I was more interested in things related to differential equations, which are what the quadratic equation related to fluids is about. In graduate school at Princeton in the 1960s, topology was very much in a golden age. There was, for example, a certain theorem that we heard about as new graduate students. Suppose you have a smooth
solid ball of earth, and you have very fine grass growing on the ball. If you try to comb
the grass flat, there is always some place where the grass will stick up. This is a special
case of a vast generalization of this essentially topological statement.

In any space – under very general circumstances – when you have any ordinary
differential equation, which means you have a direction in which you want to move
specified at each point, there is a certain very pertinent topological invariant, an integer
number called the Euler characteristic. If this number is non-zero (and it is two for the
smooth surface of the ball), then for any ordinary differential equation on this space,
there always has to be a place where the direction field has to have a singularity. You
cannot lay the direction field flat. I was very impressed by this, because it solved a
general problem. It was a simple statement. It gave a criterion to decide whether or not
you could have a differential equation without singularities on a given space.

Thus, at Princeton one was easily attracted to study topology, which has a very
geometric origin but uses the power of algebra to study the geometry of space. The
field of algebraic topology was developed quite far during that golden age at Princeton
based especially on the ideas of Norman Steenrod. One could compute in algebra and
make deductions about geometry. The above mentioned theorem, the Euler Character-
istic Theorem, seemed fantastic, because it showed how this algebraic invariant com-
pletely solved that particular problem about singularities in the theory of ordinary
differential equations. So I pursued this type of thinking for about a decade, studying
algebraic topology and developing some algebra related to differential forms which
influenced and became part of what is now called homotopical algebra.

Topology studies a space by breaking it up into little boxes, or cubes in the case
of three-dimensional spaces. Then it studies how the different pieces fit together, mak-
ing an algebraic structure out of the linkage between the different pieces. The advan-
tage of this over the idea of Newton, which is the idea of the infinitesimal or of calcu-
lus, is that here in this combinatorial world of algebraic topology you have only fi-
nitely many entities in a combinatorial relationship or in an algebraic relationship, and
with this algebra one finds out rather deep properties of the space. So topology is de-
termined by these configurations of little cubes, and it does not matter how you divide
the space into cubes. You squeeze out information from any decomposition into cubes.
It is a powerful method. The disadvantage, which will be discussed below, is that this
finite picture enjoys less symmetry than the picture of Newton. This symmetry does
not disappear completely, but is remembered approximately using Steenrod’s ideas.

One might now ask: where did this idea of algebraic topology come from? Here is
one part of the story. In following Newton’s ideas on the motion of the planets, it turns
out you can solve exactly, as Kepler had foreshadowed, certain simple problems. How-
ever, as soon as you add one more body to the solvable configurations, the Newton equations are too complicated to solve explicitly. Poincaré invented the topic of qualitative dynamical systems to help discern patterns in these difficult-to-solve situations. Simultaneously and in parallel, Poincaré introduced topology, both algebraic and geometric. Many who were near to my generation around that time in the 1970s became involved in topology, pictures and dynamical systems, and further tools were developed and absorbed.

One day at the Institut des Hautes Études Scientifiques (IHES) in Paris, which is interdisciplinary between mathematics and physics, I wandered into a lecture in physics. After a great deal of discussion about harmonics, it became clear that the seminar was studying fluids by equations and formulae. I was astonished because they had the equations that described how fluids moved around in space, and they could start trying to calculate. But because of Newton’s infinitesimals, arbitrarily high frequency harmonics had to be utilized, or in other terms, they had to consider not only cubes of a fixed size, but in principle had to go down to cubes of an infinitesimal size. There were infinitely many things one had to compute. The answers might not converge. They might not make sense. They might not approximate anything. I thought to myself, “What? This is a beautiful equation and it describes fluids, but one doesn’t know whether the solutions can be computed? One doesn’t know whether solutions exist?” I was astonished because these equations are used in the aircraft industry to build airplanes; engineers use them all over the world to model everything. Fluids exist; they know what to do. We have a beautiful equation, and yet the basic foundation – the mathematics, or the epistemology of this equation – is very sparse. If you start with a smooth initial condition, the fluid evolves for a small amount of time, depending on that initial condition. Then it may start to get more violent, the time of predictability or control gets shorter and shorter, and then maybe – like those two real zeros of the quadratic equation – they come together, and – poof! – the solution disappears.

I needed a break from the end game and from writing about results on the Feigenbaum renormalization conjectures I had been working on for nearly a decade. I wanted to try to find out why that three-dimensional fluid problem was so hard. I was not so presumptuous as to assume I could realistically work on this problem per se because I was not in that branch of mathematics, and I knew prodigious experts in that domain who had not been able to solve it. But one could still ask, “Why is this problem so difficult? Why is it not solved? Why can’t it be solved?” Fluids are very real and this model is beautiful and it goes back for centuries. It is the right model from the Newton calculus point of view. What is going on? Maybe one can modify the question to a more tractable one.
It turns out that it is not difficult to find out what is going on. It turns out that for this equation, the amount of information that the equation gives is of two types. One is that the total energy is controlled, and you can use that. The other is local. The volume density and the twisting or vorticity is preserved. Fortunately, energy is a number. You have so much energy to spend, like a budget. That is all you have; the fluid has to get by with that amount. Volume density is also a number at each point. But vorticity is not a number; it is what we call a tensor. It has a direction and a magnitude at every point, and it is preserved in the sense that the fluid moves this tensor around, transforming it appropriately, and in that transformed sense, vorticity is preserved.

Now, this is the picture in three-dimensional space. If the fluid is restricted to a surface [the atmosphere in some respects fits this description], vorticity measures locally the spinning in a plane tangent to the surface, the vorticity direction is pointing out of the surface at all points. So it is not really a complicated tensor, but rather a number, the amount of twisting at each point. In fact, in two dimensions, you have two preserved scalar quantities: area density and scalar vorticity. The foundational theory of two-dimensional fluid equations is completely and beautifully worked out based on the preservation of these two scalars. The mathematics is perfect. The problem in three dimensions, then, is that somehow the preserved quantities are more elaborate and the methodology of partial differential equations has not yet made use of the tensorial preserved quantity to control the solutions of three-dimensional fluid motion.

In fact, in a recent paper and blog, the famous mathematician Terence Tao has actually produced an evolution equation similar to the fluid equation with friction or viscosity which has exactly the same energy and volume qualities. But by making the different scales interact in a very technically complicated way, Tao actually gets solutions of this equation to blow up in finite time. The role of vorticity is altered by the friction.

So we learn one idea from the success in surface fluid flow. We should focus more on vorticity in three-dimensional fluid flow. Vorticity has always been geometrically attractive (as in Arnold’s work) even though it is preserved only in this more complicated tensorial sense. We also can use common sense and pursue a practical idea. In dimension two, where the mathematical theory is quite complete, calculating fluids is still not a completely successful endeavor. So the second idea is to emphasize the vorticity version of two dimensional fluid equations coupled with Steenrod’s considerations to create computational algorithms that are successful. This makes sense, because we know that what we are trying to compute actually exists in the Newtonian mathematical model. If we can do this, we will use the same ideas to invent algorithms
in dimension three that may help compute fluids practically, whether or not the desired foundational mathematics is actually true in three dimensions.

Let’s discuss the methodology in the practical second idea. This comes from algebraic topology and it directly addresses the non-linear or quadratic term in the equation via Steenrod’s hierarchy of homotopies. In this discussion one can start, as is widely understood, to discretize the equations using linear principles from algebraic topology (finite differences, averages and the relationship between bulk and boundary integrals). One obtains algorithms that may depend on how the continuum equation is written and discretized.

Let me explain. If you have the Newton continuum model for the fluids, you can write the continuum equations in many different ways, because Newton’s calculus has all sorts of beautiful algebraic properties: commutative multiplication, associative multiplication, certain formulae for differentiation and so on. Then you can take one of these ways and give it to an applied mathematician or a scientist engineer, who may attempt to put it on a grid and discretize it.

We believe now that the different ways of writing continuum equations and then discretizing them to first order or second order in different continuum formats may well lead to rather different algorithms. However, we also believe that if we continue the discretization at one scale incorporating the Steenrod hierarchy of corrections to the breakdown in the discrete world of the algebraic symmetry of the continuum world, we obtain discretization schemes that though quite different at low orders become essentially equivalent when the entire hierarchy is used. We may be finding a conceptual approach to taking a non-linear problem, discretizing it into algorithms and understanding mathematically the different discretizations.

The key idea is to use a Steenrod type hierarchy of small deformations that corrects the necessary breaking of algebraic symmetry in discretization processes applied to nonlinear problems expressed in the continuum language. There is more I can say here.

Suppose actual solutions to the actual fluid evolution equations expressed in terms of differential forms are encoded into these hierarchical models in a manner consistent with the principles of homotopical algebra alluded to above. A colleague at CUNY, John Terilla, has recently communicated a very simple and elegant way to do this. It follows that the measurements of the real solution as tabulated by integrals over pieces of the cubical decomposition of the hierarchical models can also be computed from solutions to the combinatorial evolution models defined by the models. The proof is based on the principles of homotopy invariance from algebraic topology as manifested in homotopical algebra.
The idea of the Balzan Project is to take these topology ideas, apply them to the non-linear three-dimensional fluid equation using algorithms with the hierarchy of corrections. Young researchers, with their knowledge of computer programming, can thus use the resources of the project to actually test the various theoretical algorithms that can be generated. They can get answers that are correct when the continuum model of fluids has solutions. These can be checked against empirical data. We expect the computed answers will thus be meaningful and useful even while the level of theoretical certainty about the continuum model for fluids in three dimensions remains rather sparse.

To close, I report that there is one class of finite dimensional models (not yet enriched with the Steenrod hierarchy of corrections), which has all of the properties of the continuum fluid model in terms of preserved quantities, including vorticity. Moreover, this class of models is characterized by these invariance properties. This class has one further property expressible and provable using finite dimensionality. The new property is the following: there is a Gaussian type statistics or measure on the set of fluid states, which is invariant under the evolution in the model. This leads to a conjecture that makes sense in infinite dimensions for the continuum model. It is that for almost all initial conditions relative to the limiting Gaussian measure, the solutions to the 3D fluid equations can be uniquely defined for all time.
Many thanks Professor Sullivan for your thoughtful speech. Before the break and the second part of this afternoon session, just two comments. First, I hope that each of you has time to look at the Overview of the Balzan Prizewinners’ Research Projects. Second, the 2014 Annual Balzan Lecture by Professor Terence Cave was held in Berne in October. It went very well. We have already held five of these lectures, with alternation between humanities and sciences. In a certain sense, each of the Balzan Prizewinners is a candidate for next year’s Annual Balzan Lecture, which spreads knowledge.

So many thanks. After the break, we will reconvene for the second and final session.
Session II

Enrico Decleva, President of the International Balzan Foundation “Prize”; former Rector of the State University of Milan; former President of the Conference of Italian University Rectors (CRUI)

We can now go on with the second session of our afternoon, and the first presentation is one of the prizewinners, David Tilman, and Professor Godfray will present him.

Presentation of David Tilman, 2014 Balzan Prize for Basic/applied Plant Ecology

Charles Godfray, Hope Professor of Zoology at the University of Oxford and Fellow of Jesus College; Fellow of the Royal Society

It is a great pleasure to present Professor David Tilman as the winner of the 2014 Balzan Prize in Plant Ecology, and I would also like to welcome David’s wife, Cathy, and his son, Andrew, who are here this afternoon. It is appropriate, but not deliberate, that the Balzan Foundation is giving a prize in ecology this year, because it is approximately a century since the foundation of the subject. It was a hundred years ago last year that the British Ecological Society was formed; a hundred years next year that the American Ecological Society was created, and the continental societies followed in the next few years. What I want to do is to describe three themes that have permeated the history of ecology over the last one hundred years, themes that I think introduce some of the work and ideas that David will be talking about in a few moments.

For the first fifty years or so of ecology, the subject was to a large part quantitative natural history, attempting to take the rich tradition of looking at plants and animals and trying to make it into a science. It is very interesting to read the work of Ian Hacking, who we also celebrate today and who has looked at the history of how other fields became quantitative, a little earlier, during the nineteenth century. Indeed, it would be wonderful for someone like Ian Hacking to write a history of ecology in the early twentieth century. Such a study would reveal different schools and movements: an Anglo-American tradition of quantitative natural history linked to names such as Charles Elton, and a different approach with origins in physiology that treated communities of plants and animals almost as if they were organisms (or super-organisms). Fascinatingly, on the Continent, there was a French school of phytosociology that at least to modern eyes seemed to owe more to Emile Durkheim than it did to Charles Darwin.
Many aspects of these schools coalesced in the 1960s and the 1970s around a more dynamic approach to trying to understand how communities are put together. The major figures here were the American biologist – originally a physicist – Robert MacArthur, and a previous winner of the Balzan Prize and another ex-physicist, Robert May. Another important person was the British plant ecologist John Harper, who laid the foundation for modern quantitative plant population biology. David Tilman is the pre-eminent plant ecologist of the next generation who is responsible for much of modern plant population dynamics, though as Dave said yesterday in his acceptance speech, his work draws on numerous earlier researchers, including Vito Volterra, a very well-known Italian scientist.

The first theme that one can trace in Dave Tilman’s work is the importance of competition between plant species. Indeed, Dave is responsible for much of our current understanding of how competition affects plant population dynamics. As an animal ecologist, I am quite jealous of one advantage Dave has: plants compete for a relatively small number of essential requirements for growth – light, water, space, nitrogen, phosphorus, and a few other nutrients. Competition amongst animals is much more complex! Dave developed an extremely satisfying theory to explain plant competitive interactions, much of which he has tested in laboratory and field studies. Compared to animals, plants are obviously characterised by their inability to move, at least if you discount seeds and pollen. When I first became an ecologist this gave us animal biologists a decided advantage as we could use theory that assumed populations were well mixed. However, over the years, as both computing power has increased and our theory has got better, the advantage has reversed. Now, the fact that one knows exactly where plants are, and who are the other individuals they are most likely to compete with, greatly facilitates understanding how competition works.

The second theme I think of in Dave Tilman’s work is how he takes insights from the species level and applies them at the level of the community. Dave has been concerned with both how plant communities are assembled and persist, and also how plant communities affect environmental flows and services. Dave was working on biodiversity and ecosystem services before the terms were coined. He was extremely well-placed to make major contributions in this area as not only had he developed a rigorous dynamic theory of plant community ecology, but he had also initiated one of the largest and long-term ecological experiments ever set up: the fabulous facility at Cedar Creek. David tested much of the theory that he had produced by replicated experiments where he reconstructed different communities of perennial grassland species. Because he had all these facilities, and because he had this wonderful, intricate understanding of the way this community interacted, he was able to do experiments to
explore whether diverse communities fix more carbon, or are better at filtering water – in short, whether biodiverse communities are better at providing many of the important ecosystem services upon which we all rely.

Now I think that if I had been asked in the early 1990s whether there would be an effect of biodiversity per se on these ecosystem processes, I would have said probably, but the effect would be weak. I would be interested to know what Dave’s opinion at that time was. The extraordinary conclusion from over 25 years of experiments by Dave and his team is how strong this effect is. His findings have revolutionized the way we think about biodiversity, and have changed the way we explain to politicians, decision-makers and the general public why it is more than just for reasons of stewardship and ethics that we need to preserve biodiversity for future generations.

That brings me on to my last and third strand in Dave’s activities. There has been a long history amongst ecologists and population biologists in engaging in issues of importance to society. If you are an ecologist – especially if you are a plant ecologist – you are very well positioned to talk about future food security because, ultimately, virtually all our food comes from plants. Over the last ten years or so, including currently in this week’s edition of *Nature*, Dave has been hugely influential in talking about how environmental and plant ecological processes affect food security. To give you one example, for those of us in the environmental community, it is very easy to look at modern agriculture and say, “agricultural intensification, the use of lots of fertilizers, lots of insecticides, must by definition be bad.” However, what Dave has argued very convincingly is that if we do care about biodiversity, if we do care about maintaining a rich and varied community of plants and animals and habitats into the future, we are never going to be able to do that if we do not have food security. And we have to look at the system *in toto*. In fact, if we care about reducing climate change and reducing greenhouse gas emissions, we may have to concentrate our food production in some areas through a process of sustainable intensification in order to have the space to preserve and maintain rich biodiversity elsewhere.

I hope by elaborating on these three themes, I have explained to some degree why Dave Tilman is one of the most important ecologists working today; that not only is he an ecologist who has made fundamental contributions to our basic understanding of plant (and indeed animal) communities, but that he is also someone who has made important and increasingly influential contributions to the way we think about stewarding natural resources into the future.

Dave, please come and tell us more about your research.
The most unique feature of life is the amazing number of different shapes, types and sizes of plants and animals that coexist with each other on Earth. Indeed, there are at least 5 million, and perhaps as many as 10 million, different species on Earth. The existence of this biological diversity, or “biodiversity”, has raised three major scientific questions. First, why is life so diverse? Second, does biodiversity matter, that is, do changes in biodiversity impact the productivity, stability and other ways that ecosystems function? Third, why and how are human actions leading to the loss of biodiversity, and how might such losses be minimized or prevented?

Causes of Coexistence

The first of these questions is what attracted me to ecology. In the early 1970s, one of the major mysteries of ecology was how so many different species could compete with each other and coexist. This was called “Hutchinson’s Paradox,” since G. Evelyn Hutchinson had pointed out that the well-mixed waters of lakes and oceans often contained hundreds of competing species of algae, but that ecological theory predicted that the single best competitor should outcompete all other species in such well-mixed and homogeneous habitats.

This paradox highlighted the state of the discipline at that time. Ecology was mainly an observational discipline then. Mathematical theory and experiments, a combination that had led to rapid advances in physics and chemistry, were rare in ecology. I loved both mathematics and the power of experiments. Two young ecology faculty members at the University of Michigan, Steve Hubbell and John Vandermeer, inspired me to pursue PhD research that combined experiments and mathematical theory in ecology. I and many others at that time felt that ecology needed to take this step toward maturation. The early 1970s were also a time of increased awareness of environmental problems. I felt that ecology had to become a mechanistic and predictive science for it to adequately address such problems.

I was attracted to lakes and the effects of nutrient pollution on them. In many lakes, the growth rates of diatoms, which are a type of algae that makes its cell walls from silicon, are limited by concentrations of phosphate and silicate. Work I did with Susan Kilham and Peter Kilham showed that the resource requirements of two dominant diatom species had evidence of a tradeoff. One species had a low
requirement for phosphate but a high requirement for silicate. The other had a high requirement for phosphate but a low requirement for silicate. Based on some early theory of competition for two limiting resources, we realized that this type of a tradeoff between these two species might allow them to coexist in habitats that had a predicted range of phosphate to silicate ratios. In a laboratory study across about 80 different sets of environmental conditions, including different ratios of available phosphate to available silicate, we found that the theory correctly predicted the phosphate to silicate ratios for which each species won in competition and displaced its competitor, and for which the two species stably coexisted.

Next we looked at how the abundances of these two species of algae in Lake Michigan changed along a 50 km long nutrient gradient from low to high ratios of phosphate to silicate. I had grown up on the edge of Lake Michigan, and I had watched its water quality degrade from nutrient pollution. So, my work on algae was also motivated by my concern for the amazingly beautiful great lake that I loved. We found that the resource requirements we had measured in the laboratory for these two species predicted, in broad outline, where these species coexisted in Lake Michigan, and how their abundances were impacted by phosphate pollution.

The paper that came out in the journal *Science* in 1976 (1) was among the first in ecology where someone had shown that by understanding the mechanisms of interaction, the outcome of those interactions could be predicted in advance. However, at that time it was not at all clear if such mechanisms and seeming predictive ability were unique to the two species we had happened to study, or, alternatively, if similar processes might explain patterns in species abundances and the coexistence of the millions of species inhabiting Earth.

While continuing to do additional experiments on various species of algae, I also began to expand and generalize the theory of resource competition, which resulted in my first book (2), published in 1982. The book applied the ideas of interspecific tradeoffs and mechanisms of competition for resources to terrestrial plants, insects, and vertebrates. It predicted how patterns in species abundances and biodiversity for each of these types of organisms should change along major environmental gradients. Such predictions were compared to data available from some well-studied ecosystems, especially from the Park Grass Experiment at Rothamsted, England.

I sent G. Evelyn Hutchinson a draft of my first book before it was published, and he wrote back and said something like, “David, this is all well and interesting, but why isn’t there some species that disobeys these tradeoffs? Shouldn’t something be able to
evolve and be better than this?” Hutchinson’s question was incredibly insightful and motivating. I have pondered it and pursued it ever since.

A major conclusion from this book, which was bolstered by analyses in a second book that appeared in 1988 (3), was that the ability of many different competing species to coexist with each other was dependent on interspecific tradeoffs. Put simply, there seemed to be only one logically viable theoretical explanation for why the earth had so many competing and coexisting species. Coexistence of multiple species was predicted to require evolutionarily unavoidable tradeoffs. Motivated by Hutchinson, I realized that an evolutionarily unavoidable tradeoff results if and only if a mutation or genetic recombination that causes an individual to better deal with some limiting aspect of its environment necessarily made that individual less able to deal with some other limiting aspects of its environment.

By this time I had switched from working on diatoms in lakes to studying perennial plant species of the native prairie grasslands and savannas that cover the middle of North America. A variety of our field experiments showed that, despite the great complexity of perennial plants relative to single celled diatoms, the same basic theory correctly predicted the outcome of competition among perennial prairie plant species. Such species, we found, were limited by and had tradeoffs in their abilities to compete for soil nitrate versus light. We also found that another factor, the ability of seeds to disperse into open sites, was involved in these tradeoffs.

**Habitat Destruction and Extinction**

The tradeoff between dispersal ability and the ability to compete for a limiting nutrient led to new theory, and to two unexpected theoretical predictions. Species become better competitors for a limiting soil nutrient, such as nitrate, by having a higher proportion of their biomass in roots, but in so doing they unavoidably have proportionately less biomass in leaves, stems or seeds. Since it takes leaves and stems to capture light and provide roots with the energy they need to survive, the main tradeoff the prairie perennials faced was between roots and seeds. Surprisingly, a simple mathematical model of competition predicted that a potentially unlimited number of species could coexist in a homogeneous but spatial habitat solely because of a competition versus dispersal tradeoff.

In collaboration with my colleague Clarence Lehmann, who honors me with his presence here today, and Robert May, an earlier recipient of a Balzan Prize, we next used this model to predict how habitat destruction would impact extinction. We found that the model predicted that there need be no immediate extinc-
tions caused by habitat destruction, but rather that even moderate habitat de-
struction caused time-delayed but deterministic extinction. More surprisingly
we found that the species that were predicted to go extinct were the very species
that were the best nutrient competitors and thus the most abundant species in the
fragments saved from destruction. We suggested that global habitat destruction
might thus be threatening the most efficient plant species on earth with eventual
extinction.

**Biodiversity and Ecosystem Functioning**

After spending two decades studying how so many species could coexist with each
other across the ecosystems of earth, two events conspired to focus my work on a dif-
ferent aspect of biodiversity. The first event was a small scientific meeting in Bay-
reuth, Germany, where we discussed the recently proposed idea that the number of
species in an ecosystem might influence how an ecosystem functions, including the
possibility that greater biodiversity should lead to greater ecosystem stability. Those
discussions led me to evaluate, in collaboration with John Downing, how a major
drought – the worst drought of the past 50 years for the region in which I was working
– had impacted ecosystem stability. Analysis of data from more than 200 grassland
plots showed that plots with many plant species (greater plant biodiversity) before the
drought were more resistant to the drought and recovered from it more rapidly. This
was the first rigorous evidence lending credence to the biodiversity and ecosystem
functioning hypothesis (4).

I knew that this finding would be met with considerable skepticism and that only
a well-designed field experiment that directly manipulated plant biodiversity could
address the questions that would be raised by our drought study. By the time our
drought paper appeared, my colleagues and I had established the first plant biodiver-
sity field experiment. Shortly after that we began using models of multi-species com-
petition and coexistence to determine how changes in the number of coexisting spe-
cies were predicted to impact ecosystem productivity, stability and susceptibility to
invasion by exotic species. Within a decade more than a hundred other biodiversity
experiments had been performed on a wide range of organisms by researchers from
around the world.

Our biodiversity experiment and the vast majority of the other biodiversity experi-
ments have shown that the number of plant species in an ecosystem is a major deter-
minant of ecosystem productivity, stability and invasibility. In particular, greater plant
biodiversity can lead to a doubling, or more, of ecosystem productivity, to greater
ecosystem stability, to greater retention of limiting nutrients, and to much lower rates of invasion by exotic species (5).

**Consequences of Biodiversity Loss**

In 1990, few academic ecologists thought that the loss of biodiversity would have much of an effect on ecosystem functioning. However, because of all the experiments that have been done on this issue, there is now perhaps more rigorous support for the effects of the loss of biodiversity on ecosystem processes than there is for any other issue.

Why does biodiversity matter? The basic answer is this. Biodiversity exists because of the interspecific tradeoffs that allow so many interacting species to coexist with each other. Tradeoffs mean that each species becomes specialized on doing one thing very efficiently, but at a cost. Specialization necessarily means that each species does many other things poorly. When species interact with each other, it is the strength of each species that defines the role it plays in an ecosystem. The weaknesses of a given species become irrelevant to ecosystem functioning when many other species are present. In essence, in the open and competitive interactions of nature, each additional species adds to the overall efficiency of the ecosystem, making it more productive and more stable. This is a simple verbal description of the predictions of mathematical models in which species coexist because of interspecific tradeoffs.

The most recent work that we have done shows how such effects of biodiversity are not limited solely to competitive interactions. For instance, we have studied the effect of plant biodiversity on the rest of the food chain – such as the 500 or so species of insects that live in the plots of our biodiversity experiment. This work has shown that greater plant biodiversity led to greater insect diversity, and had an unexpected impact on the insect communities. When plant diversity was low, the insect community was dominated by insect species that ate the plant species, which are called herbivores. However, at high plant diversity, insects that were predators dominated the insect community. These insect predators kept the herbivorous insects at low levels, further increasing the positive effects of plant diversity on ecosystem productivity.

Three decades ago almost all ecologists would have told you that the most important variables determining ecosystem productivity were soil fertility, climate and herbivory. At the same site where we have our biodiversity experiment, we also have experiments that manipulate soil fertility by fertilization, that change climate via warming and water removal or addition, and that manipulate the abundances of herbi-
vores. When we compared the effects of these and other variables on ecosystem productivity with the effects of changes in plant biodiversity, we found that the effects of biodiversity were as large or larger than the effects of any of these other variables. Biodiversity is one of the key variables determining how ecosystems function.

**Universal Tradeoffs**

Although the results of numerous biodiversity experiments are consistent with the hypothesis that all organisms face unavoidable tradeoffs, this hypothesis raises its own paradox, much like the question that Hutchinson asked me. Darwin proposed that natural selection, by favoring heritable traits that were beneficial, should lead to the evolution of new species that were superior to existing species, and that these superior species, if they migrated to a new continent, would competitively displace the established species when they invaded.

Paleontologists have found that the number of species on Earth has been increasing in a roughly linear manner for hundreds of millions of years. This means that when speciation led to the appearance of a new species on Earth, on average, each new species did not cause an existing species to go extinct. If that had happened, diversity would have leveled off. Instead, each new species coexisted with the species that were there before. This pattern would seem to question the traditional concept of the process of evolution: are new species truly better if they do not displace existing species?

The fossil record also provides a different way to answer this question. It documents the dynamics of many major events, called biogeographic interchanges, when species that evolved in one realm have invaded a new region during the past 500 million years. Analyses of these interchanges fail to support the conjecture that newly evolved species were truly superior to established species. In none of these interchanges did the invasion of species that had evolved in one realm lead to the extinction of species in the new realm. Rather, the established and invading species consistently coexisted for periods of millions of years. Such long-term coexistence is predicted to only occur if the established and invading species had all long been bound to a single, universal tradeoff curve (6).

The deeper meaning of this finding is that the evolution of new species has, for the past half a billion years, been more about evolution while bound to an unavoidable tradeoff surface than about any species gaining any traits without also experiencing concomitant costs. This tradeoff is the likely explanation for why almost all newly evolved species have coexisted with established species rather than outcompeting them.
Biodiversity Ethics

Given all that we now know about the causes of the Earth’s great biodiversity, about how human actions are endangering biodiversity, and about the effects of the loss of biodiversity on ecosystem functioning, it should be clear that the preservation, conservation and restoration of biodiversity should be a high global priority.

Biodiversity is the “economic capital” of nature, the ecological endowment upon which human life depends. The world’s marine and terrestrial ecosystems remove and store almost two-thirds of all the greenhouse gasses that we release by burning fossil fuels. We depend on thousands of species for our food and fiber. We depend on innumerable species for ecosystem services such as purification of water, decomposition of wastes, and the production of the fertile soils. The wild plants and microbes of the Earth’s remaining ecosystems are the biodiversity from which we discover the majority of new medicines. We receive these services form nature for free, but only if we preserve biodiversity.

Human societies face tradeoffs. We have become the dominant force impacting ecosystems worldwide. Our impacts have outpaced our ethics. Our environmental and land-use ethics and laws were devised during an era when the human population, one-tenth its present size, tamed wilderness with ox and axe. Now, every ecosystem, and the fate of its biodiversity, is subject to the whims of society. The world needs an ethic that values the well-being of all future generations by preserving for them the greatest riches that the earth holds – its biodiversity.

Reference Notes


Questions and Comments

Charles Godfray

Are there any questions from the audience? Marc, do you have one?

Marc Van Montagu

Don’t you think that growth-promoting bacteria are also important for plants, that you also have then a much higher diversity of growth-promoting bacteria because the bacteria always goes in relation to species and that gives them hormones that help everybody? They are the mediator in what you observed.

David Tilman

Yes. We are working now with people who use wonderful modern molecular techniques, so they can identify the microbial biome, if you will, in the soil, and see how microbes respond to plant diversity, and try to understand what roles they’re playing. So you ask a very important question. I have no reason to imagine anything other than the effects of biodiversity we see with plants happen with various bacteria and other elements of the food web. I think that in the next decade or so we should have lots of insights on this issue.

Charles Godfray

Another question from one of our science journalists.

Marco Ferrari

Thanks for the wonderful speech. If biodiversity means higher productivity, why in civilization, is the path of human civilization toward less biodiversity and less biodiverse agriculture?

David Tilman

Well, the simple answer is that much of what is produced when you talk about higher productivity is not edible. We don’t eat grass ourselves. And we don’t eat trees.
We tend to eat seeds of annual plants for some of our main crops. And in that regard, if you look within annual plants, such as wheat or other grains, there’s good work now showing that having a diversity of genotypes actually leads to higher productivity than growing a single genotype. In crops that are hybridized, we put the genes inside the plant. Our hybrid plants have two different genes at every locus in their genome, and that diversity of genes actually lets those plants be more productive than the lines that aren’t hybridized.

So we use diversity in little ways right now in agriculture, but I think you ask a fundamental question that merits a lot more attention in agriculture. And that is, “How can we use diversity as a tool to have agriculture be more sustainable and more productive?” I don’t have instant answers; we’re at the beginning of these questions.

Charles Godfray

Thank you. Professor Brunori?

Maurizio Brunori

I have a short question. The struggle for food is a fundamental component of evolution and survival. I mean, at face value, would you say it sounds like a contradiction with evolutionary theory, unless there is something which is abundant in any event for all the species? Have you done some of these experiments under conditions in which the food – let’s call it this way – of the different plants was limiting? Because that’s the situation. When growing bacteria, if you have very little food, very little glucose, then there is the survival of one and the loss of the other. At face value it seems like a contradiction with Darwin’s theory, but obviously it’s not.

David Tilman

No, it’s not a contradiction, but you ask a good question. In fact, one of the first criticisms of our experiment was that we did it on unusually nutrient-poor soils and therefore it wasn’t relevant to the rest of the world. We did our work on sandy, low-nitrogen soils, and I defended myself by saying one third of the land surface has sandy soils. But a better answer is this: there are limiting factors for all organisms across the face of the world, and diversity can only exist when there are limiting factors. Because only when there are factors which limit fitness can many species coexist with each other. So coexistence depends not just on tradeoffs, but on tradeoffs for factors that
limit fitness. Species have differentiated their use of nitrogen by time of year and climate as a result of their competitive interactions. So probably the same axes of differentiation that led to speciation cause multiple species to coexist.

Charles Godfray

Another question from the audience?

Member of the audience

I personally do think that GMOs are a good opportunity for the future of agriculture. How about the relationship between the GMO and biodiversity?

David Tilman

Well, I also agree that GMOs are something which could be very important for letting us continue to produce food. The most serious problem that crop plants face are rapidly evolving diseases. Crop breeding goes on continually, with breeders trying to stay ahead of rapidly evolving diseases. What GMOs allow us to do, among many other things, is to bring in genes from other kinds of grass than the ones we’re growing, or maybe other kinds of plants, and in some cases other kinds of organisms that we couldn’t bring in before. So I think in the long term, especially since we have a world where 60% of our calories only come from three species, we can’t afford to lose any of these species. We need to keep them productive. I think it’s going to be a very important tool. I would argue that some GMOs were released too soon. They weren’t used as wisely as they could have been, because we’ve had an evolution of herbicide resistance, evolution of resistance to Bacillus thuringiensis genes, and so on. We’re losing important tools very, very quickly. We need these tools. We need to use them in a wise way that keeps them available for the long term. Thank you.

Charles Godfray

Dave, if I can ask you a question. Most of your experimental work has been on relatively short-lived perennial and annuals. Do you think if you apply your theory to longer-lived plants, especially trees, it will need to be applied in a different way? Will there be a greater role for random stochastic effects?
David Tilman

If I were to speak tongue in cheek, I might assert that everything we’ve found on our plants applies to every other organism in the world. However, clearly much more work will be needed to find out if or how the responses of trees might differ from perennial grasses. I should mention, though, that I have never done any work on annuals. All of these prairie plants are long-lived perennials that may live fifty or a hundred years – perhaps as long as some tropical trees live.

Charles Godfray

Ok, so is there a final question? In that case, will you join me in thanking Dave for a fabulous presentation.

Enrico Decleva

I thank Charles Godfray very much for his extensive presentation, and Professor Tilman for his important speech. I don’t know if it is correct to note it, but both of the winners that we have just heard, Professor Sullivan and Professor Tilman, make a great use of their hands. It’s a signal, I believe, of the passion they put into their work and their research. It’s important to have passion in research.
Presentazione di Mario Torelli, Premio Balzan 2014 per l’archeologia classica

Enrico Decleva

È ora la volta del premiato per l’archeologia classica, Professor Mario Torelli. E nessun luogo è più adatto di Roma a fare da sfondo a una tale presentazione, per la quale passo la parola al Professor Paolo Matthiae, componente del Comitato Generale Premi.

Paolo Matthiae, Vicepresidente del Comitato Generale Premi della Fondazione Internazionale Balzan “Premio”

Signor Presidente, colleghi, signore e signori. Mario Torelli, nato a Roma nel 1937, dopo aver insegnato nelle Università di Cagliari e di Perugia e aver tenuto corsi e seminari nelle più prestigiose università soprattutto degli USA, del Regno Unito, della Francia e del Canada, è oggi membro dell’Accademia Nazionale dei Lincei e di numerose altre istituzioni accademiche europee e americane, e ha ricevuto la laurea honoris causa delle Università di Tubinga in Germania e di Jaén in Spagna. Archeologo di vastissima dottrina e di stupefacente dominio delle fonti, è studioso di grandissimo acume critico e di eccezionale capacità interpretativa, che ha dedicato studi di spiccata originalità e di visione ampia a molti problemi cruciali dei principali ambiti storici della cultura antica, dal mondo greco a quello etrusco e a quello romano.

I suoi studi sono stati in più casi fondata sulla sua attività di ricerca sul campo, tra le quali si ricordano gli scavi da lui diretti del santuario etrusco di Porta Caere a Veio, del santuario mercantile greco di Gravisca, porto di Tarquinia, del santuario extraurbano di Afrodisia Venere a Paestum, del santuario di Demetra e dell’agorà di Eraclea: le sue interpretazioni degli scavi di questi luoghi sacri hanno avuto una risonanza e un’influenza particolarissime, così come le mostre su vari aspetti della civiltà etrusca da lui progettate in Toscana, a Venezia, a Cortona e a Roma, tra il 1985 e il 2008.

Le sue sintesi magistrali sulla storia, sulla società e sull’arte degli Etruschi sono esemplari sia per la profondità delle analisi che per la solidità dei giudizi storici, mentre l’ampiezza dei suoi interessi emerge dai due saggi sull’urbanistica greca e romana. Il grande tema del rilievo storico romano, indagato sia attraverso valutazioni tipologiche e strutturali sia attraverso gli aspetti del rango e del rito nella produzione delle immagini, è stato affrontato in contributi particolari e in sintesi generali in maniera risolutivamente innovativa.
L’incontro tra dati archeologici, letterari ed epigrafici elaborato per far emergere i contenuti dell’ideologia dominante in età arcaica è il nucleo di una serie di studi fondamentali dedicati alla ricostruzione di riti di passaggio romano-latini come a Lavinio, di rilevanti complessi monumentali nei massimi centri del mondo classico, come quello dell’Afrodite Sosandra sull’Acropoli di Atene o dell’Ara Massima di Ercole a Roma, fino ai programmi figurativi di celebri monumenti come il ciclo delle metope dello Heraion alla foce del Sele, il Cratere François o il Trono Ludovisi.

L’archeologia della religione in ogni suo aspetto e della produzione artigianale della Grecia d’Occidente è il soggetto della sua più recente sintesi in cui le tradizioni greche, i fermenti italici, l’impatto latino trovano felicissime soluzioni interpretative. In anni di ripetute crisi metodologiche che hanno in parte sfiorato e in parte investito l’archeologia classica anche per l’urto delle tendenze neo-archeologiche, il rigore delle sue impostazioni di metodo, sensibile alle innovazioni interdisciplinari ma non alle mode suggestive ma effimere, impegnato sempre per una storicizzazione radicale delle esperienze antiche, al di là di generalizzazioni inadeguate a cogliere la specificità delle situazioni storiche puntuali, è stato ed è tuttora un luminoso punto di riferimento per generazioni di studiosi in Italia, in Europa e in America.

Questo è il giudizio della commissione.

Enrico Decleva

Professor Torelli, prego, a Lei la parola.
Panorama della carriera e presentazione dei progetti di ricerca

Ripercorrendo cinquanta anni di studi e di carriera, due cose mi appaiono fondamentali nella vita e nel lavoro di un archeologo: i maestri e la fortuna.

Comincio quindi con un pensiero di sincera gratitudine a tutti i miei insegnanti, dalle elementari all’università, espressioni di un sistema scolastico di prim’ordine quale è stato quello italiano fino a trent’anni or sono. Non so quanti giovani di generazioni più recenti possano dire di aver avuto altrettanta fortuna.

Nel corso degli studi liceali e nei miei primi due anni di università, come solo il folle titanismo dei giovani sa fare, ho saggìato infinite vie, dal cinema, come critico, allo studio della lingua cinese, durato ben quattro anni, fino alla scoperta della politica, vissuta come esperienza di vita e di cultura. Per la mia persona, vita politica e vita culturale, professione di archeologo e intellettuale engagé sono stati per oltre tre decenni una sola cosa, secondo un modello che mi è stato offerto da Ranuccio Bianchi Bandinelli, rigoroso militante del Partito Comunista Italiano, grande maestro e storico dell’arte greca e romana, da me incontrato nello stesso anno cruciale 1957, quando Bianchi Bandinelli fu chiamato alla cattedra di Archeologia e Storia dell’Arte Greca e Romana dell’Università di Roma, malgrado il voto contrario di tutti gli archeologi della Facoltà di Lettere. Nato nel 1900, Bianchi Bandinelli è cresciuto nel clima neoidalistico che ha dominato l’Italia per oltre mezzo secolo: nel 1973, alla vigilia della morte, nella prefazione alla terza edizione del suo libro più importante Storicità dell’arte classica, sul quale si sono formate almeno tre generazioni di studiosi, ebbe a scrivere che la sua adesione al marxismo è stata politica e non filosofica. In maniera del tutto paradossale, oggi posso dire che la mia situazione, come quella di qualche altro intellettuale dell’Europa meridionale, è specularmente inversa a quella che quaranta anni or sono denunciava Bianchi Bandinelli: la mia adesione al marxismo resta nella sostanza di natura filosofica, ma malinconicamente non politica. Ma sono felice di aver dedicato, in nome di questa passione, un grande impegno, oltre alla normale vita di partito, alla fondazione e alla crescita della rivista Dialoghi di Archeologia (1967-1992), di cui Bianchi Bandinelli mi lasciò erede assieme a tre altri amici fondatori, e poi alle attività del gruppo di antichisti attorno all’Istituto Gramsci (1986-1994), tutte esperienze per me fondamentali, che, pur nel radicale cambiamento dei tempi, ho caparbiamente tentato di far rivivere fondando nel 1991 la rivista Ostraka.

Per mia grande fortuna, grazie alla conoscenza e all’esempio di una personalità come quella di Bianchi Bandinelli, il destino di archeologo che scelsi per me si colo-
rava di intense passioni e di altrettanto intenso studio, senza che per questo mi abban-
donasse l’inquietudine culturale che aveva contraddistinto la mia prima giovinezza. Scelsi di laurearmi con Massimo Pallottino, il fondatore della moderna etruscologia italiana; tuttavia, subito dopo la laurea, iscritto nel 1960 alla Scuola Nazionale di Archeologia di Roma, feci ancora un altro incontro che imprimerà un segno profondo nella mia vita di archeologo. Alludo alla circostanza che mi portò a essere allievo (1961-63) dei seminari di epigrafia latina, tenuti in casa dal grande epigrafista Attilio Degrassi: nato in una Trieste ancora austro-ungarica, Degrassi aveva frequentato l’U-
niversità a Vienna, dove era stato allievo di uno dei migliori collaboratori di Theodor Mosmsen, Eugen Bormann, al quale si deve il volume XI del Corpus Inscriptionum Latinarum contenente le iscrizioni di Etruria ed Umbria. La grande dottrina di De-
grassi e il suo stile di docente schivo, ma di immensa umanità, hanno impresso una svolta alle mie ricerche: le mie prime pubblicazioni importanti, dedicate a epigrafi latine di un certo interesse (avevo scoperto, fra l’altro, un’iscrizione che rivelava l’i-
dentità della nonna di Crispina, moglie di Commodo), nascono nei suoi seminari, con l’edizione di materiali da me raccolti negli anni precedenti nel sito di Trebula Mutue-
sca, dove avevo contribuito tra il 1958 e il 1959 a organizzare un cantiere di scavo assieme ai miei amici di gioventù, Adriano La Regina, Filippo Coarelli e Fausto Zevi. Oltre a insegnarmi non solo le tecniche dello studio delle iscrizioni, ma anche parec-
chie nozioni di carattere istituzionale e antiquario, che mi sarebbero state preziose negli anni a venire, Attilio Degrassi mi ha fatto capire che il nostro lavoro di archeo-
logo può trovare la giusta dimensione solo confrontandosi con storici veri: di qui la mia assiduità, che quasi sempre è diventata amicizia, con tanti storici dell’antichità, da Ettore Lepore ad Emilio Gabba, da Filippo Cassola ad Arnaldo Momigliano, da Luigi Moretti a Domenico Musti, per ricordare, tra i molti con i quali ho intrecciato fecondi rapporti, i soli nomi di quelli che ci hanno purtroppo lasciato.

L’etruscologia era stata la materia della mia tesi di laurea: desideroso, sempre per il giovanile titanismo (o forse per l’altrettanta giovanile presunzione), di emulare l’e-
sempio di Bianchi Bandinelli, la cui tesi su Chiusi era stata pubblicata nel 1925, e di Pallottino, che nel 1939 aveva pubblicato la sua dissertazione su Tarquinia, avevo chiesto di svolgere una tesi su un’altra grande città dell’Etruria, Faleri. Tuttavia, a differenza di quello dei miei due maestri, il lavoro da me portato a termine nel 1960 ha raggiunto un livello assai modesto, una mediocrità dovuta non solo alla mia presun-
tuosa inesperienza, ma anche all’inaccessibilità dei materiali nel Museo di Villa Giulia, allora in rifacimento proprio nell’ala destinata ai Falisci. Malgrado i miei rapporti assai spigolosi con chi mi aveva portato alla laurea, nel 1963 la tesi su Faleri mi è al-
meno servita per la carriera, perché si è potuta trasformare nell’argomento di una
prova scritta, che la Commissione giudicatrice valutò con un voto assai lusinghieroassieme a quella orale: vinsi così il concorso per Ispettore archeologo nelle Soprintendenze e ottenni l’ambita sede di Villa Giulia a Roma.


Quest’ultima scoperta, che ha confronto solo a Naucrati in Egitto, purtroppo scavata alla fine dell’Ottocento, ha cambiato ancora una volta il corso della mia esistenza: già il susseguirsi di rinvenimenti di luoghi di culto nel corso del mio lavoro di soprintendenza mi aveva spinto a dedicare sempre maggiore attenzione alla documentazione archeologica del sacro e alla religione antica, in parte esplorata nello sviluppo giovanile degli interessi epigrafici e antiquari. Ora però l’enorme quantità di materiali ceramici greci e la peculiarità dei meccanismi dello scambio, mediati dal santuario attra-
verso la presenza di una pluralità di presenze divine, da Afrodite ad Adone, da Demetra ad Apollo, ciascuna con il proprio culto e il proprio regime di offerte, mi hanno obbligato a spostare radicalmente e quasi a tempo pieno i miei studi verso il mondo greco e in particolare sui meccanismi ideologici e sui significati socio-economici delle relazioni di scambio sviluppate tra Greci ed Etruschi. In buona sostanza, è stato ancora una volta il caso – la Fortuna – a spingermi allo studio delle strutture sociali e dell’economia greca, etrusca e romana arcaica, in congiunzione con i dati antropologici, proprio in quegli anni entrati con decisione fra gli ingredienti della ricerca di ambito greco.


L’aver scoperto il ruolo di ideologia dominante svolto nel mondo classico dalla religione, che si è posta come struttura capace di organizzare i rapporti sociali attraverso il mito in Grecia e attraverso il diritto fondato sulla ritualità religiosa a Roma, temi sui quali ho potuto scrivere più di un saggio, è stato per me la linea-guida per numerose indagini sul mondo greco-romano, e sulle civiltà etrusche e pre-romane d’Italia. Ho perciò trovato quasi ovvio il tentativo di ricostruire organici programmi figurativi greci fondati sui codici etici del mito e delle consuetudini religiose, che hanno ispirato monuments celebri della pittura vascolare greca, come il “Cratere François”, o la decorazione scultorea di un grande tempio arcaico, come lo Heraion alla foce del Sele, fino alla scoperta di santuari “dimenticati”, come quello di Afrodisia Sosandra sull’Acropoli di Atene; parallelamente a ciò, mi è stato possibile analizzare invece i c.d. rilievi storici romani in una prospettiva giuridica, fondata sulla cerimonialità religiosa e sul ritualismo delle formule alla base della mentalità tanto dei committenti quanto degli spettatori (1992). In altre parole, poiché le categorie religiose e le consuetudini rituali rappresen-
tano il velo, attraverso il quale i monumenti figurati si presentano a noi, nostro compito è “rimettere sulle gambe” i messaggi, che l’antichità voleva con quei monumenti indirizzare al suo pubblico, di cui spesso l’archeologia contemporanea ha invece alterato i codici di comunicazione e le finalità di persuasione, modernizzandone i significati.

Questa prospettiva, tuttavia, non è affatto cosa limitata al solo mondo della rappresentazione, ma è alla base di una serie di fattori che hanno influenzato gli aspetti più diversi della produzione umana, oggetto delle ricerche dell’ archeologo: fra questi aspetti, un significato fondamentale hanno la forma, la funzione e la collocazione urbanistica degli edifici, una fenomenologia intrinsecamente legata all’ideologia e al potere, di cui vanno decifrati i nessi con i momenti salienti della vita collettiva e con i cerimoniali propri di quella cultura, concetti che sono alla base di molti miei lavori, come le indagini su alcuni monumenti di Roma, il templum Solis con l’ Arco di Portogallo, l’ Atrium Minervae e l’ Ara Maxima Herculis. Questa precisa serie di convinzioni costituisce l’ossatura ermeneutica di una parte rilevante dei miei lavori degli ultimi trenta anni, che hanno toccato tutte le epoche dell’antichità e molti aspetti della documentazione archeologica, con l’obiettivo di demistificare un gran numero di luoghi comuni del sapere diffuso, molti dei quali posso dire con soddisfazione che ormai sono diventati punti fermi e acquisizioni solide della ricerca, dal riconoscimento del vero significato dei pinakes di Locri, fino all’identificazione nella pianta del circo del modello ultimo delle grandi basiliche funerarie di epoca costantiniana di Roma, passando attraverso la ricostruzione del significato simbolico e cerimoniale dei fregi decoranti templi e residenze aristocratiche etrusche e latine di epoca arcaica.

Come ognuno avrà potuto constatare, le scelte di metodo e dei diversi ambiti di ricerca hanno risposto assai bene all’inquietudine e alla divorante curiosità, che hanno costituito sin dall’adolescenza il fondo della mia indole e che mi hanno fatto ricercare esperienze non di rado agli antipodi dei miei usuali interessi. Non so se questo abbia nociuto alla concentrazione delle mie ricerche o alla profondità delle eventuali conquiste; ma di una cosa sono convinto, e cioè che si può far progredire la scienza archeologica solo contaminando – sempre come sistemi e mai come nozioni frammentarie e staccate – evidenze fra loro a volte lontanissime, dagli specialisti tanto gelosamente quanto infruttuosamente sorvegliate, solo usando tutte le fonti letterarie, epigrafiche, archeologiche e antropologiche disponibili, lavorando sulla forma, la collocazione e i significati politici e istituzionali dei monumenti, e studiando la rappresentazione e le iconografie. La rappresentazione va indagata non con le indagini miopi e banali sugli schemi figurativi, cari a tanti tradizionalisti affezionati a questo filone di studi, bensì con la ricerca di messaggi figurati spesso non evidenti a prima vista, come ci hanno insegnato gli esempi di Warburg, di Panofsky e di Haskell.
Ora, a conclusione quasi di questi accenni autobiografici, vorrei rapidissimamente presentare le linee di ricerca del progetto che voglio avviare – perché fanno parte integrante del profilo che vi ho delineato. Il centro di questo progetto è l’interferenza fra culti risalenti a culture diverse, venute a contatto tra l’età protostorica e quella arcaica e classica. Una prima linea di ricerca verrà dedicata a un vistoso caso, senz’altro dai mille volti, di interferenza religiosa tra la Grecia e il mondo latino, etrusco e italicò, costituito dal culto dei Dioscuri, di cui si indagheranno aspetti archeologici e storico-religiosi anche dell’area di origine, laconica e tarentina, e magnogreca. L’ingresso nell’Italia non greca di questo culto è senz’altro frutto dell’intenso rapporto tra mondo etrusco-latino e mondo greco di madrepatria e delle colonie, che si è avviato tra VIII e VII secolo a.C., e che si è andato progressivamente estendendo tra l’età arcaica e quella ellenistica a tutte le società della penisola con inaudito successo, le cui ragioni di fondo restano però sostanzialmente sconosciute. Della vasta casistica di questa interferenza tra area greca e culture non greche verranno indagati con proprie linee di ricerca altri esempi significativi, a partire da quello, ormai giustamente famoso, del santuario emporico di Gravisca, porto di Tarquinia, dove tra 590 e 480 a.C. mercanti greci, in prevalenza greco-orientali, hanno commerciato con la controparte etrusca, sotto la protezione di divinità venerate con dediche e iscrizioni sia nell’aspetto greco che in quello etrusco: si progetta di pubblicare due classi di materiali, ultime da essere comprese nell’edizione definitiva, quella delle ceramiche arcaiche verniciate, di chiara ispirazione ionica, e quella delle anfore da trasporto greche ed etrusche.

Sempre attorno all’interferenza tra mondo etrusco-latino e mondo greco verranno presi in considerazione altri due casi di grande importanza. Il primo riguarda il culto di Apollo e il secondo il caso di Circe, isolatissimo, ma di eccezionale interesse. Delle infinite testimonianze della presenza del dio di Delfi in Italia se ne è prescelta una, quella che una recente ipotesi – peraltro controversa – attribuisce ad Apollo il tempio dell’Ara Rotonda di Ostia: è lecito attendersi che lo studio dei materiali, tuttora inediti, scoperti anni addietro nello scavo della cella, e il riesame complessivo della documentazione archeologica, epigrafica, topografica e monumentale portino dati nuovi per una più certa identificazione della divinità. Il secondo caso è costituito dal culto di Circe, la dea al centro di uno dei più importanti miti dell’Odissea. Il santuario a lei dedicato sorgeva presso la colonia latina di Circei (393 a.C.), che da quella mitica maga e dal promontorio sede del culto ha preso il nome. La redazione di una tesi dottorale appena discussa, dedicata a quel centro e alle molte altre sue antichità, ha potuto dimostrare l’infondatezza della tradizionale identificazione con una villa (la c.d. “Villa dei Quattro Venti”) di un colossale basamento sostenuto da sostruzioni volte
in opera incerta. Sia i dati raccolti dalla diligente analisi delle strutture che la scoperta all’interno del complesso di una dedica votiva di età repubblicana suggeriscono invece di riconoscere in questo grande monumento il santuario di Circe e di accostare il poderoso insieme architettonico ai c.d. “santuari sillani” del Lazio, come quelli della Fortuna Primigenia a Palestrina e di Ercole Vincitore a Tivoli. Analizzato nel quadro complessivo del comprensorio archeologico di Circei, questo santuario verrà discusso soprattutto in relazione con quanto diverse fonti ci dicono in rapporto con il luogo di culto di Circe.

Al grande tema dei c.d. santuari “sillani” si ricollega anche la ricerca sul santuario di Giunone Sospita a Lanuvio, iniziata già tre anni fa sotto la direzione di Fausto Zevi. La ricerca proseguirà sempre sotto la direzione dello stesso Zevi, affrontando lo studio dei materiali ceramici rinvenuti nello scavo e allargando le indagini all’area del santuario inferiore di epoca tardo-repubblicana e imperiale: entrambi gli studi consentiranno di ottenere non solo informazioni più articolate sulle fasi protostoriche e arcaiche, nelle quali si colloca la genesi del culto, ma soprattutto dati planimetrici più precisi, quelli relativi alla fase di monumentalizzazione tardo-repubblicana del santuario, che collega la trasformazione del complesso santuariale in una grandiosa architettura tardo-ellenistica di tipo scenografico.

Non meno significative sono le interferenze verificatesi sul piano religioso tra vari *ethne* della penisola: di queste interferenze sono noti alcuni casi, ai quali sono state riconosciute caratteristiche proprie dei santuari interetnici. Di questi luoghi di contatto etnico e culturale verrà prescelto un esempio, sempre pertinente all’area etrusco-laziale oggetto della ricerca, quello del Lucus Feroniae, il “bosco sacro” dedicato alla dea sabino-falisca Feronia, sorto in epoca protostorica o arcaica come luogo di incontro nella Bassa Valle del Tevere, all’incrocio di grandi vie di comunicazione tra la Sabina, l’Etruria, la foce del Tevere e il territorio di Capena e di Falerii. Il santuario che perciò vede ben tre culture a contatto, quella latina, quella falisco-capenate e quella etrusca, ha restituito a più riprese un’ingente massa di materiali votivi, ammassati dopo il saccheggio compiuto da Annibale. Di tutti questi materiali saranno studiati solo quelli recuperati nelle più recenti campagne di scavo condotte dalla ex Soprintendente di Villa Giulia Anna Maria Moretti e dalla sua collaboratrice Gilda Benedettini: l’eccezionale situazione archeologica della deposizione degli oggetti votivi, tutti di qualità altissima, verrà presentata dalle scavatrici, mentre la ricerca condotta da giovani borsisti del Premio Balzan riguarderà appunto la classificazione e lo studio analitico degli ex-voto, la cui provenienza costituirà un indicatore fondamentale circa le correnti di frequentazione del santuario.
Volevo concludere la mia presentazione esprimendo la mia gratitudine profondissima alla Fondazione Balzan, che mi consentirà di proseguire un filone di ricerca che per i miei interessi è stato assai produttivo negli ultimi quindici anni e che nell’attuale ristrettezza e difficoltà, in più nella posizione di professore ormai in pensione, come la mia, avrebbe avuto scarse possibilità di realizzarsi. Grazie alla Fondazione; grazie all’Accademia per avermi concesso questa tribuna.

Comments

Enrico Decleva

Dall’intervento di Mario Torelli è emersa una passione straordinaria, che abbiamo tutti – credo – colto e che ha animato questa sorta di autoritratto insieme umano, morale e scientifico che egli ci ha proposto, facendoci percepire la sua profonda dedizione al mestiere di archeologo, inteso come parte di una dimensione culturale e di ricerca più ampia, proiettata oltre i dati tecnici, avvalendosi di competenze svariatissime, quelle appunto che devono essere proprie degli archeologi: anche se mi sembra di capire dal premiato, non lo sono necessariamente di tutti i neo-archeologi.

Mi ha fatto molto piacere la notazione finale, cioè che quel 50% di risorse che il Premio Balzan riserva per i progetti di ricerca possa servire anche nel suo caso a sviluppare indagini che hanno basi di fondo, e basi molto solide, nelle sue ricerche precedenti, ma che potranno essere sviluppate anche grazie a giovani energie. È un tema che è stato esplicitato e sviluppato anche questa mattina, nella efficacissima presentazione dei progetti di ricerca Balzan in corso, e che consente di dire che tramite la Fondazione Balzan e la configurazione dei suoi premi è davvero possibile contribuire a che giovani ricercatrici e giovani ricercatori, con le loro ricerche, possano trovare força. Per poter avviare un lavoro scientifico, continua sempre a richiedere tempo e la competenza, la passione e l’intelligenza.

Paolo Matthiae

Grazie, Presidente. Io vorrei soltanto dire che, come mi aspettavo, conoscendo da qualche tempo Mario Torelli, ci ha fatto un’assai interessante, suggestivo e come spesso capita, un poco partigiano squarcio della complessa e in parte agitata ma mol-
to feconda vita archeologica di noi sciaguratamente settantenni e settantacinquenni. Io ero un tipo molto più tranquillo di Mario, come forse molti sanno in quest’assemblea. E siamo molto grati per questo squarcio su una certa storia dell’archeologia italiana del ’900 – che bisognerebbe fare. Sarebbe molto bello se l’Accademia dei Lincei – io non c’entro nulla perché sono orientalista – con illustri archeologi che fanno una parte di questa celebre compagnia facessero… un “convegno sui destini dell’archeologia”.

Volevo sottolineare che mi pare particolarmente rilevante il tipo di ricerca che Torelli ci ha proposto, e sono convinto che sarà una ricerca molto ricca, in cui ci sarà il coinvolgimento molto ampio di studiosi, amici, colleghi, e soprattutto di molti giovani di grande valore. Questa mi pare la cosa più importante.
Closing Remarks

Enrico Decleva

At this point, the programme calls for some concluding remarks by the President of the Balzan Foundation, but more than conclusions, I must express thanks. Before doing that, of course, I again convey my most sincere congratulations to the winners of the 2014 Prizes, the main figures in our Forum today.

First of all, I thank President Lamberto Maffei and the Accademia dei Lincei, who have graciously been our hosts again this year and who have played a key role in making these events such a success. Not only today’s Forum, but also the three sessions of Inter-La*b that were held in the days before the awards ceremony, fruit of the collaboration of the Balzan Foundation, the Accademia dei Lincei and the Swiss Academies of Arts and Sciences, whom I also thank for the increasingly intense and congenial working relationship that we have established. As we all know, Professor Alberto Quadrio Curzio has been fundamental in all of this, and I would also like to most kindly thank him for opening this Forum and moderating the first session.

I should also like to take this opportunity to express my gratitude to Professor Günter Stock, our keynote speaker, for reminding us of the very important role that institutions like the academies and foundations play in promoting research. The Balzan Foundation, too, can be recognized in this perspective.

I also thank the General Prize Committee and its Chairman Salvatore Veca for the important, demanding work carried out over the course of the year. That is all behind us now, and we have been able to see the brilliant results yesterday and today. The Prizewinners’ acceptance speeches before the President of the Italian Republic yesterday and their talks today are a convincing demonstration that this year, too, our General Prize Committee – who is responsible for choosing the winners – has lived up to its high standards in exercising its responsibilities.

Finally, let me express my special thanks to the Secretary General of the Foundation, Suzanne Werder, and to all of those who have worked hard over these past months with a sense of commitment and selflessness to make these days a success. Perhaps I am not the one who should say this, but I have the impression that we have succeeded.

One last word of thanks to all of those who have followed this Interdisciplinary Forum of the 2014 Balzan Prizewinners – in hopes of seeing many of you next year in Berne, and in two years again in Rome. As an old song from my youth goes, “Arrivederci Roma”.
The 2014 Prizewinners’ Research Projects
Ian Hacking, Professeur honoraire, Chaire de philosophie et histoire des concepts scientifiques, Collège de France; University Professor Emeritus, University of Toronto, was awarded the 2014 Balzan Prize for Epistemology and Philosophy of Mind for his fundamental and pioneering contributions to philosophy and the history of social and natural sciences, for the thematic breadth of his research, for his original epistemological perspective centred on a version of scientific realism and defined in contrast with the dominant paradigm in the philosophy of science of the twentieth century.

**Styles of Reasoning**

Balzan Research Project undertaken by the University of Toronto, on behalf of Professor Ian Hacking. Deputy Supervisor: Professor Cheryl Misak, FRSC

**Aims and Objectives**

The aim of the *Balzan Styles of Reasoning* research project is to contribute to the important, wide-ranging work of Professor Ian Hacking, 2014 winner of the Balzan Prize, through the support of young researchers, conferences, and publications.

The *Balzan Styles of Reasoning* research project will allow young, emerging scholars to continue to explore styles of reasoning in the wide range of topics dealt with by Professor Hacking: medicine, psychiatry, sociology, philosophy of mind, epistemology, philosophy of science, philosophical psychology, statistical inference, the philosophy of mathematics and logic, ethics, the philosophy of language, and history.

In order to continue to advance the overarching project, detailed studies of the history of different kinds of reasoning and inquiry must be conducted. A significant proportion of the Balzan Foundation funds will be used to provide fellowships for dissertation-stage graduate students to spend an additional year to explore in depth a style of reasoning. While supported by the project they would be designated “Balzan Fellows in Philosophy”. The University of Toronto will fully fund the graduate students who are participants in the Balzan project for the first four years of their study and cover any increase in costs beyond those projected in this budget.

In each of the years of the project, funds will be made available to support four doctoral students so that they can do the full historical and philosophical study that their subjects require. The current plan is to support one graduate student in each of the philosophical areas most centrally connected to the Styles Project: The Philosophy
of Mind, Epistemology, Philosophy of Science and Mathematics, and Social and Political Philosophy.

In addition, for each of the four years of the project, money will be made available for one or more visiting international graduate students writing dissertations in areas relevant to work on these topics at the University of Toronto and to form a substantive community of scholarship. Every effort will be made to find students from around the world working on these topics so that they might benefit from the intellectual resources of the University of Toronto, as well as contribute to a deeper understanding of how the various styles of reasoning and kinds of inquiry make us who we are.

In the fourth year of the research program, an international conference will be held in which students who have contributed to the Styles of Reasoning project will return to the University of Toronto to report on the results of their research. Whereas the precise organization of panels for the conference will depend in part on the specific research areas of the students working in them, a major two-day conference is planned, with principal papers presented by students who have worked in the Styles Project and commentaries by more established but still relatively junior researchers. The papers presented at the conference will be published in high-impact journals like the Canadian Journal of Philosophy and other major university presses.

All publications, conferences, websites, scholarships and visitorships will acknowledge the generosity of the Balzan Foundation in making this vital project possible. The Deputy Supervisor, Professor Cheryl Misak, will provide annual reports on the progress of the project.
Dennis P. Sullivan, Albert Einstein Professor of Science and Distinguished Professor of Mathematics, the City University of New York Graduate School and University Center (CUNY); Professor of Mathematics, State University of New York at Stony Brook (SUNY), was awarded the 2014 Balzan Prize for Mathematics (pure/applied) for his major contributions to topology and the theory of dynamical systems, opening new perspectives for generations to come. For his exceptional results in many fields of mathematics, such as topology, geometry, the theory of Kleinian groups, analysis and number theory.

Computing Three-Dimensional Fluids

In order to compute fluid motion, any fluid model must be discretized in terms of finitely many parameters. Discretizing space by dividing it into cells was Poincaré’s starting point when he invented topology to study qualitative dynamical systems just over one hundred years ago. In the middle of the twentieth century, great advances were made in algebraic topology, which is also based on these cells. These advances were related to the algebraic products that are involved in the discretization process for the nonlinear term of the fluid models.

When discretizing, certain algebraic symmetry in the ideal models is broken. This loss of symmetry is correctable by an elegant hierarchy of corrections based on these algebraic topology advances. These corrections are similar but not exactly the same as the Feynman diagrams used in the algorithms to compute physical effects in quantum theories.

Sullivan and his students and colleagues have long been engaged in understanding the connections and building theoretical algorithms for fluid computations based on these conceptual ideas. His colleagues at the CUNY Graduate Center have begun one set of computations using one of these algorithms in dimension two. At Stony Brook, his colleagues in applied math have made many computations based on the ideas of their discipline. Their work led to the unprecedented revelation that different ways of writing the ideal model which are equivalent at the ideal level are inequivalent at the discrete level.

There is a coherence, however, if one allows for the extended sequence of corrections alluded to above. Systematically testing the various algorithms in terms of their extended corrections would hence prove to be beneficial, in particular, connecting with known fluid data in performing these tests. With the second part of his Balzan Prize, Sullivan would take up a project that he has wanted to carry out for some time,
that is to say, initiating the practical part of this theoretical work, which is essentially complete.

The project will primarily be based at Stony Brook University, with parts being carried out at the Graduate Center of the City University of New York. At Stony Brook, the nearly finished graduate student Cameron Crowe will be supported in post-doctoral work for two years. Cameron understands the theoretical part, as well as computer code. At least two colleagues from the Applied Mathematics Department will be consulted and engaged as consultants. At CUNY, one mid-career colleague and Sullivan’s former student, Scott Wilson, will join in full-time for at least six semesters and two summers. Scott understands the theory, knows many programming languages and has already been playing with one of the algorithms in a simple case. As part of their thesis work, two junior graduate students at CUNY, Aradhana Kumari and Samir Shah, will also be involved in the effort, with financial support for five semesters. It is hoped that this experience will increase the young researchers’ employability in the academic world.
**G. David Tilman**, Regents Professor, McKnight Presidential Chair in Ecology and Director of the Cedar Creek Ecosystem Science Reserve, University of Minnesota; Professor, University of California, Santa Barbara, was awarded the 2014 Balzan Prize for Basic/applied Plant Ecology *for his huge contributions to theoretical and experimental plant ecology, work that underpins much of our current understanding of how plant communities are structured and interact with their environment.*

**Biodiversity: Causes, Consequences and Conservation**

*Aims and Objectives*

G. David Tilman has spent his career pursuing answers to three major scientific questions related to biodiversity. First, why is life so diverse? Second, how do changes in biodiversity impact the productivity, stability and other ways that ecosystems function? And finally, why and how are human actions leading to the loss of biodiversity, and how might such losses be minimized or prevented?

In trying to answer these questions he has formulated a ‘universal tradeoff’ hypothesis, which suggests that a deep underlying unity of causation explains why the world became so diverse and why biodiversity has such large impacts on how ecosystems function.

The second half of Tilman’s Balzan Prize will be used for a project in which he will work with young scholars to address three issues related to his ‘universal tradeoff’ hypothesis and its implications:

1. how evolutionary and ecological processes interact to cause speciation and diversification;
2. why the effects of biodiversity on ecosystem functioning are so unexpectedly large;
3. the mechanisms whereby human actions could cause species extinctions, the number of species so threatened, and ways to prevent such extinctions.

1. Causes of Biodiversity

Tilman’s goal is to thoroughly test the limits of applicability of the universal trade-off hypothesis and seek data sets that might refute it. This will be done by determining if its logical implications are supported by a reexamination of the fossil record, by deeper exploration of the mechanisms that allow competing species to coexist, and by examination of the forces that allow multispecies coexistence across the full range of...
trophic interactions, not just competition. The evolutionary implications of the universal tradeoff hypothesis also must be tested, such as by determining if the pattern of micro-evolutionary changes in multispecies communities are consistent with the universal tradeoff hypothesis, and with how such tradeoffs then might influence speciation and subsequent coexistence.

Research staff planned: Tilman with the assistance of one or two younger scholars (PhD students or post-doctoral researchers, whom he would recruit based on their skills and interests).

2. Why are Biodiversity Effects so Large?

Although Tilman’s experiments in the Midwest USA as well as those of other researchers have found large effects of biodiversity, there is as yet no rigorous theoretical explanation for the magnitude of the diversity effects. In conjunction with either a PhD student or a post-doctoral researcher, Tilman will re-explore both underlying theory and data gathered over the past 20 years of biodiversity experimentation.

3. Causes of Extinctions, and Ways to Prevent Extinction

In collaboration with a post-doctoral researcher or a graduate student, Tilman will synthesize existing evidence and related mathematical theory on human-caused extinction threats, with the aim of testing existing theories and seeking new theories that can integrate the simultaneous effects of multiple stressors to predict their interactive effects on extinctions.

Collaboration and Publication

Younger scholars will be involved as collaborators and co-authors of papers on the research proposed above over the next five years, hopefully publishing them in disciplinary journals, as well as in some multidisciplinary journals such as Science and Nature.

Tilman also plans to immediately start work on writing a book that would summarize his past work and establish the conceptual foundation for the issues outlined above. The book will not be multi-authored, but will involve mentoring an advanced undergraduate university student with a stellar academic record in ecology or evolution who can benefit greatly from spending a year assisting with his research.
Duration of the Project and Collaborating Institution

Tilman intends to use Balzan research funds over a five year period, with funds allocated to supporting two post-doctoral researchers, two or three PhD students and advanced undergraduate students (or students who have recently completed their undergraduate degrees). Other funds will be used to cover research supplies and travel costs.

The funds are to be administered by the University of Minnesota Foundation, with Dr. Clarence Lehman and Dr. Forest Isbell of the University of Minnesota (St. Paul) Department of Ecology, Evolution and Behavior acting as Deputy Supervisors.
Mario Torelli, Professore di Archeologia e Storia dell’Arte greca e romana, Università di Cagliari and Università di Perugia; Emeritus since 2010, was awarded the 2014 Balzan Prize for Classical Archeology for the profoundly innovative character of his studies in all of the main fields pertaining to the cultures of the ancient world, from Greek to Etruscan to Roman, and for the great relevance of his methodological experimentation and his archaeological discoveries. For the originality of his work, in which historical-epigraphic investigation, iconological analysis, historical-religious evaluation and anthropological research come together in a well-founded, overarching vision that is always supported by perceptive attention to the economic and social structures as well as the ideological and institutional aspects of ancient cultures.

**Ancient Sanctuaries in the Area of Etruria and Lazio: Religious and Cultural Interference**

As a direct continuation of a three-year project on “Virgilian sanctuaries” carried out for three years by Mario Torelli and Fausto Zevi at the Accademia Nazionale dei Lincei, the second half of Torelli’s Balzan Prize will start when the former project ends in March 2015. “Virgilian sanctuaries” has focused on two sanctuaries: Castrum Inui on the coast of Ardea, dedicated to the obscure local divinity Inuus (under the direction of Torelli); and Juno Sospita in Lanuvio (under the direction of Fausto Zevi). The two sanctuaries were among the topics addressed in a conference held in October 2013 (publications in progress), while at present work is underway on an edition of two volumes for the Accademia Nazionale dei Lincei’s prestigious series *Monumenti Antichi*, planned for 2016. These two research projects, which have departed from recent extensive excavations, have benefited from the latest, most innovative formulas of archaeology of religion and ritual. Likewise, the present project is anchored to the area of Etruria and Latina, like the “Virgilian sanctuaries” project, and will continue in the same spirit of experimentation, expanding its perspectives in various directions – archaeological, monumental, historical and historical-religious – to then move on to different lines of research constructed around the theme of the archaeology of religion and rituals.

At the centre of this six-fold project is the interference between religions coming from the different cultures which came into contact between the proto-historic age and the Archaic and Classical periods. One line of research will be dedicated to a remarkable, undoubtedly multi-faceted case of religious interference between Greece and the Latin, Etruscan and Italic world: the cult of the Dioskuri, the archaeological and his-
historical-religious aspects of which will be investigated, as will the area of origin, Laco-
nia and Taranto. Italy’s entrance into this non-Greek cult is undoubtedly the fruit of
the intense relationship between the Etruscan and Latin world and world of the Greek
motherland and its colonies, which started between the VIIIth and the VIIth century
BCE and progressively expanded to all of the societies on the peninsula between the
Archaic and Hellenistic ages. Nevertheless, the underlying reasons essentially are still
unknown.

From the wide-ranging case history of this interference between the Greek area
and non-Greek cultures, other significant examples will be studied with precise lines
of research, starting with the justly renowned sanctuary-emporium of Gravisca at the
port of Tarquinia, where between 590 and 480 BCE Greek merchants (mainly Greek-
Orientalizing) traded with their Etruscan counterparts under the protection of divini-
ties venerated in both their Greek and Etruscan aspects in dedications and inscrip-
tions: two types of materials are planned for publication, to be included as the last two
volumes in the final edition of the excavations, one on archaic painted ceramics of
clear Ionic inspiration and the other on Greek and Etruscan transport amphorae. The
study of these two types of ceramic materials may furnish useful diagnostic data on
the precise provenance of both the Greek and the Etruscan merchants.

In addition, two more cases of interference between the Etruscan-Latin world and
the Greek world will be taken into consideration. The first concerns the cult of Apollo;
the second, the case of Circe, which is very isolated, but of exceptional interest. From
the boundless evidence of the presence of the god of Delphi in Italy, one case was
chosen, in which a recent controversial hypothesis attributes the temple of the Round
Altar to Apollo in Ostia: the as of yet unpublished study of the materials discovered
years ago in the excavations of the cella and the overall re-examination of the ar-
chaeological, epigraphic, topographical and monumental documentation are expected
to lead to new data for a certain identification with the divinity.

The second case concerns the cult of Circe, the goddess at the centre of one of the
most important myths of the Odyssey. The sanctuary dedicated to her rose in the
Latin colony of Circeo (393 BCE), which took its name from the sorceress of myth
and from the promontory where the cult was located. The editing of a recently de-
fended doctoral thesis on the centre and its many antiquities has shown that the tradi-
tional identification of a colossal base supported by vaulted structures in opera in-
certa with a villa (the so-called Villa dei Quattro Venti) is unfounded. Both the data
collected by the diligent analysis of the structures and the discovery of a votive dedi-
cation from the Republican period on the inside of the complex suggest instead that
this great monument can be identified as the sanctuary of Circe, and that the imposing
architectural complex can be recognized as one of the “Sullan sanctuaries” of Lazio, like Fortuna Primigenia in Palestrina and Hercules Victor in Tivoli. Once the general framework of the archaeological district of Circeo has been analysed, this sanctuary will mainly be discussed in relation to what different sources say about the relationship with the place of the cult of Circe.

On the larger theme of the so-called Sullan sanctuaries, a link will be re-established with research on the sanctuary of Juno Sospita in Lanuvio, already begun three years ago under the direction of Fausto Zevi, who will continue to supervise the research, addressing the study of ceramic materials found in the excavation and expanding investigations to the area of the lower sanctuary of the late Republican and Imperial era. Both studies will make it possible to obtain not only more articulate information on the Proto-historic and Archaic phases, to which the birth of the cult is dated, but also more precise data on the plan in terms of the late Republican, monumentalizing phase of the sanctuary, which in fact connects the transformation of the sanctuary complex to the grandiose, scenographic architecture of the Late Hellenistic period.

No less significant are a few known cases of interference that took place in the religious sphere between the various ethne on the peninsula, for which the characteristics of inter-ethnical sanctuaries have been recognized. Pertinent to the Etruria-Lazio area that is the subject of this research, one example of such a place of ethnical and cultural contact has been chosen from among these different places: the Lucus Feroniae, or “sacred woods” dedicated to the Sabine-Faliscan goddess Feronia. The sanctuary, which witnessed contact among three cultures (Latin, Faliscan-Capenate and Etruscan), has on several occasions revealed an enormous quantity of votive materials amassed after it was sacked by Hannibal. However, only those retrieved in the most recent excavation campaigns carried out by former Superintendent of the Villa Giulia, Anna Maria Moretti, and her collaborator, Gilda Benedettini, will be studied. The extraordinary archaeological situation of the deposition of the votive objects, all of very high quality, will be presented by the excavators, while the research carried out by young Balzan research fellows will in fact concern the classification and analytic study of the ex-votos, whose provenance will constitute a fundamental indicator of the currents that used the sanctuary.

Before starting work, in the course of a day-long conference that is planned for the month of January at the Accademia Nazionale dei Lincei, an extraordinary, very recently excavated example of cultural and ideological interference between worlds and cultures in contact with each other will be discussed: the great complex of Monte Prama (OR), where, on several occasions between 1975 and the present day, a high number of colossal stone statues clearly pertinent to Nuraghic culture have been dis-
covered. The excavations just finished by the University of Sassari have brought to light part of a necropolis with tombs that the statues were connected with. They were probably produced following foreign, perhaps Orientalising, influence, and have definitively confirmed the funerary destination of the impressive sculptures, whose more remote inspiration has been widely debated in the past. Even if they lie outside the Etruscan-Italic area that this research focuses on, the case of Monte Prama is an indispensable example of possible contact between two cultures, the Nuraghic and the Phoenician, and will provide an important contribution to the discussion related to the forms of, reasons for and sources of inspiration at the root of ideological interference in the Mediterranean area and a possible model of eventual analogous cases in the Etruscan-Italic area. All of the costs of the conference will be covered by the University of Sassari, and publication of the conference proceedings is planned in the series of the *Atti dei Convegni Lincei*, with an explicit reference to the research project funded by the Balzan Prize.

For these six projects, Mario Torelli has worked out a research plan that will involve graduate and doctoral fellowships, purchase of materials and research tools, mission expenses and various kinds of scholarly production, including monographs and articles in academic journals.
Profiles

The International Balzan Foundation

The International Balzan Foundation “Prize” aims to promote, throughout the world, culture, science, and the most meritorious initiatives in the cause of humanity, peace and fraternity among peoples, regardless of nationality, race or creed. This aim is attained through the annual award of prizes in two general academic categories: literature, the moral sciences and the arts; medicine and the physical, mathematical and natural sciences. Specific subjects for the awarding of Prizes are chosen on an annual basis.

Nominations for these prizes are received at the Foundation’s request from the world’s leading academic institutions. Candidates are selected by the General Prize Committee, composed of eminent European scholars and scientists. Prizewinners must allocate half of the Prize to research work, preferably involving young researchers.

At intervals of not less than three years, the Balzan Foundation also awards a prize of varying amounts for Humanity, Peace and Fraternity among Peoples.

The International Balzan Foundation “Prize” attains its financial means from the International Balzan Foundation “Fund”, which administers Eugenio Balzan’s estate.

The Accademia Nazionale dei Lincei

The Accademia Nazionale dei Lincei, founded in 1603 by the Roman-Umbrian aristocrat Federico Cesi and three other young scholars, Anastasio De Filiis, Johannes Eck and Francesco Stelluti, is the oldest scientific academy in the world. It promotes academic excellence through its Fellows, whose earliest members included, among many other renowned names, Galileo Galilei.

The Academy’s mission is “to promote, coordinate, integrate and disseminate scientific knowledge in its highest expressions in the context of cultural unity and universality”.

The activities of the Academy are carried out according to two guiding principles that complement one another: to enrich academic knowledge and disseminate the fruits of this. To this end, the Accademia Nazionale dei Lincei organises national and
international conferences, meetings and seminars and encourages academic cooperation and exchange between scientists and scholars at the national and international level. The Academy promotes research activities and missions, confers awards and grants, publishes the reports of its own sessions and the notes and records presented therein, as well as the proceedings of its own conferences, meetings and seminars.

The Academy further provides – either upon request or on its own initiative – advice to public institutions and drafts relevant reports when appropriate. Since 1992, the Academy has served as an official adviser to the President of the Italian Republic in relation to scholarly and scientific matters.

The Swiss Academies of Arts and Sciences

The Association of the Swiss Academies of Arts and Sciences includes the Swiss Academy of Sciences (SCNAT), the Swiss Academy of Humanities and Social Sciences (SAHS), the Swiss Academy of Medical Sciences (SAMS), and the Swiss Academy of Engineering Sciences (SATW) as well as the two Centres for Excellence TA-SWISS and Science et Cité. Their collaboration is focused on methods of anticipating future trends, ethics and the dialogue between science, the arts and society. It is the aim of the Swiss Academies of Arts and Sciences to develop an equal dialogue between academia and society and to advise Government on scientifically based, socially relevant questions. The academies stand for an open and pluralistic understanding of science and the arts. Over the long-term, they mutually commit to resolving interdisciplinary questions in the following fields:

- They offer knowledge and expertise in relation to socially relevant subjects in the fields of Education, Research and Technology.
- They adhere to the concept of ethically-based responsibility in gaining and applying scientific and humanistic knowledge.
- They build bridges between Academia, Government and Society.
Agreements on Collaboration between
the International Balzan Foundation “Prize”,
the Accademia Nazionale dei Lincei and
the Swiss Academies of Arts and Sciences

(Hereafter referred to as the ‘Balzan’, the ‘Lincei’ and the ‘Swiss Academies’, respectively)

The main points of the agreements between the Balzan, the Swiss Academies and the Lincei are the following:

1) The promotion of the Balzan Prize and the presentation of the Prizewinners through the academies’ channels of communication, in Italy and Switzerland as well as abroad. By virtue of the relations of the Swiss Academies and the Lincei with academies of other countries and with international academic organizations, they will contribute to more widespread circulation of news related to the Balzan;

2) On the occasion of the Awards ceremony of the Balzan Prize, held on alternating years in Berne and Rome, each academy will contribute to the academic organization of an interdisciplinary Forum, in the course of which the Prizewinners of that year will present their academic work and discuss it with other academics proposed by the academies. Furthermore, in the years when the ceremony is held in Rome, one of the Prizewinners will give the Annual Balzan Lecture in Switzerland, and when the ceremony is held in Berne, the Annual Balzan Lecture will be organized at the headquarters of the Lincei in Rome;

3) The academies will contribute to a series of publications in English (ideally with summaries in Italian, German and French), created by the Balzan, with the collaboration of the Balzan Prizewinners.

To promote and supervise all these initiatives, two Commissions have been set up, one between the Balzan and the Lincei, and the other between the Balzan and the Swiss Academies. Both commissions are chaired by Professor Alberto Quadrio Curzio as a representative of the Balzan, while the Balzan Secretary General, Dr. Suzanne Werder, has been appointed Secretary of both Commissions.