THE PANEL OF JUDGES OF THE INTERNATIONAL CATALONIA PRIZE, MADE UP OF THE MEMBERS OF THE ADVISORY COUNCIL OF THE CATALAN INSTITUTE FOR MEDITERRANEAN STUDIES, MEETING AT THE UNESCO OFFICES IN PARIS ON 26 FEBRUARY 1993, AGREED BY ABSOLUTE MAJORITY TO AWARD THE V INTERNATIONAL CATALONIA PRIZE TO LUIGI LUCA CAVALLI-SFORZA, FOR THE FOLLOWING REASONS:

FIRST: FOR SUMMARIZING FOR THE FIRST TIME THE THEORETICAL BASIS FOR POPULATION GENETICS AND FOR HIS PART IN THE DISCOVERY OF SEXUAL EXCHANGE BETWEEN BACTERIA, A KEY ELEMENT IN THE DEVELOPMENT OF MOLECULAR GENETICS IN THE LAST THIRTY YEARS. HIS RECONSTRUCTION OF DEMOGRAPHIC DEVELOPMENTS LINKED TO THE NEOLITHIC EXPANSION IN EUROPE IS TO DATE THE BEST-KNOWN AND MOST WIDELY ACCEPTED CONTRIBUTION BY GENETICS TO THE RECONSTRUCTION OF THE PAST.

SECOND: FOR HIS SCIENTIFIC WORK, A MODEL OF INTERDISCIPLINARY INVESTIGATION, SINCE WHILE HIS STARTING POINT IS GENETICS, HIS WORK, ALMOST ALWAYS CARRIED OUT IN A TEAM, EXTENDS INTERACTIVELY INTO VARIOUS FIELDS: ARCHAEOLOGY, DEMOGRAPHY, ETHNOLOGY AND LINGUISTICS.

THIRD: FOR HIS HUMANIST AND SCIENTIFIC INSIGHT IN CONSIDERING HUMAN INTELLIGENCE AND RACES, SINCE FOR LUIGI LUCA CAVALLI-SFORZA THE CONCEPT OF RACE LACKS ANY SCIENTIFIC MEANING AND HE THEREFORE REJECTS ALL RACIST CONCEPTS ON SCIENTIFIC GROUNDS. HE ALSO HAS AN ANTI-DETERMINIST APPROACH TO HUMAN INTELLIGENCE: CULTURAL FACTORS ARE MORE IMPORTANT THAN PURELY DETERMINIST FACTORS, SOMETHING HE DEMONSTRATES WITH HIS ANALYSES.

CATALÒNIA OFFERS THE TEXT OF THE SPEECH MADE BY LUIGI LUCA CAVALLI-SFORZA ON 25 MAY 1993, WHEN HE WAS AWARDED THE PRIZE BY THE PRESIDENT OF THE GENERALITAT DE CATALUNYA, JORDI PUJOL.

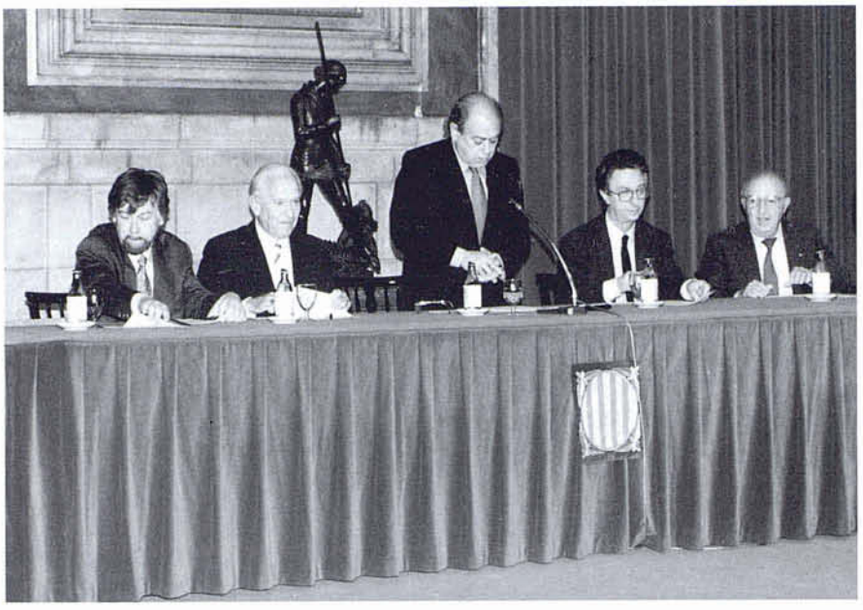
THE V INTERNATIONAL CATALONIA PRIZE

LUIGI LUCA CAVALLI-SFORZA SCIENTIST

It is a very moving thing to receive such an important prize as this, which has been awarded to me by Catalonia and which puts me amongst a group of people for whom I have great respect and admiration. Thank-you for this honour and pleasure and for having given me the opportunity to speak in Barcelona, which I like very much. Perhaps it is a mistake to try and use your language, which I do not know well, and in case that is what you are thinking at the end of my speech I shall apologize before I start. But I want to do it. I think that man is what his culture makes him and by speaking to you in Catalan I want to render homage to one of the most well-disposed of Mediterranean peoples. And anyway, our languages are very similar: the Italian of the North comes closer to Catalan, while that of the South comes closer to Castilian. Furthermore, there is still a part of Italy, more precisely in north-eastern Sardinia, around l'Alguer, where Catalan is spoken.

I don't really know why my name was chosen out of the many candidates for this prize, and the inevitable answer of course is to see in it the hand of fate, or, as people say, of luck, since the judges have to choose from people in very different fields of work, something that can be seen from the list of my predecessors in the International Catalonia Prize, who range from a theoretical physicist like Abdus Salam to an oceanographer like Cousteau. I find this variety very interesting.

But I wouldn't like anyone to get the impression that I am questioning the validity of the work of selection carried out by the panel; on the contrary, I have the greatest respect for the businesslike



way in which they have gone about the analysis and for the way in which positive and negative aspects have been taken into account. For example, I was asked to explain the reasons for criticisms that have been made of my work and, on my own recommendation, even one of my scientific opponents was asked his opinion. I find this very agreeable and reassuring. As usual, scientific work is subjected to colleagues' criticism, and it's not always easy to know who's right. If you are declared a saint –as the Latin poet says, *si parva magnis componere licet*–, the judges had better be hard; otherwise there might seem to be no place for the halo on your head.

What merits can I claim for myself? To tell the truth, I chose my work principally on the grounds that I enjoyed it, not for the greater glory of God, or of humanity, or of my family, or even of my own. I haven't made a special effort to improve the world, except by contributing to understanding ourselves better. A selfish choice, you might say, very different from that of the holy man who, in contrast, is concerned only for the welfare of others, at least outwardly. I would like to stress the importance of the basic principle of choosing a job you like, because this is the only way that real dedication is achieved and success is more likely in any work you undertake. Though the work you choose must be of some purpose. Otherwise, we would run the risk of creating a world in which all people were interested in was getting into the *Guinness Book of Records*.

I would say that my guiding principle is similar to that of the artist, and in a city like Barcelona, where art has always been supported and taken seriously, I have no need to defend it. Art is its own defence because it enriches humanity, and science is also its own defence, because knowledge is important. Obviously, a lot of people prefer technology to science, because it provides solutions to specific practical problems and can be enriching. But technology is impossible without science, and while basic science is never dangerous in itself, applied science –that is, technology– always has potentially very negative aspects which are often difficult to foresee and avoid. Who would have thought last century that the invention of the internal combustion engine would make cities almost uninhabitable?

I chose to take my degree in science because I was curious to know and understand my fellows better, and I thought that as a doctor I would do better. But after practising medicine briefly in an isolated hospital, and listening to the university lecturers, who at that time carried on like film stars, I lost all interest in staying in the medical world. After hunting around for a good laboratory in which to learn to be a researcher in biology, I was lucky enough to find a very clever genetics teacher and I realised that this field provided a mixture of theoretical thinking and experimental work which I found intellectually satisfying. I started in the genetics of drosophila and bacteria; at that time bacterial genetics was an almost unknown subject of study, but it was obviously earmarked for great success, which came later.

I spent almost three years in Britain at the end of the forties, and I was impressed by the profound seriousness and intelligence of British scientific research, which still takes first place in the world today, in quality if no longer in quantity. But I made the mistake of going back to Italy at the beginning of the fifties, when the scientific situation was still disastrous, and I found it difficult to maintain an activity that would allow me to keep abreast of foreign competition in bacterial genetics. I therefore decided to switch to human genetics, in which no work was yet being done, and, to be more precise, to population genetics, taking advantage of my interest in statistics and the archives of the Catho-

lic Church there were in Italy, which were much more difficult to find in Britain or America, where research was flourishing in those years. And so, again rather by chance, I started work in human genetics and evolution.

What I want to do now is to explain very briefly the chief conclusions of the work my collaborators and I have been doing, which obviously took as its starting point the work of others before me.

First. What we call anatomically modern man –in other words, a man so like us that we can't distinguish him from ourselves– is not more than 100,000 years old. He originated in Africa, or perhaps the area of the Middle East. He started to grow in numbers and spread to the rest of the world about fifty or sixty thousand years ago, and soon reached the farthest limits of today's inhabited world. He arrived in Europe about forty thousand years ago, almost certainly replacing the Neanderthals who lived there before that.

This demographic and geographic growth was determined by a series of biological and cultural innovations we know little about and often only indirectly, as, for example, a language undoubtedly more advanced than that of its predecessors and comparable to the languages spoken today throughout the world, which allowed effective communication. Another innovation was a new and more extensive use not only of stone tools, but of instruments made from bone and wood. Also, at least in South-East Asia, but probably also everywhere else, they had the means of crossing extensions of water of up to eighty or ninety kilometres in width.

Second. Ten thousand years ago, as a result of overpopulation and environmental changes, a technological revolution started: the production of food from agriculture and stock-raising. Until then all food was obtained from hunting and gathering. An enormous growth in population now became possible which over the ages has multiplied the number of the Earth's inhabitants by almost ten thousand. From their places of origin, the farmers spread as far as it was possible for them to take their seeds and animals.

Third. Europe was colonized again by agricultural peoples from the Middle East (so-called Neolithic man), who took four thousand years to get from their area of origin to the farthest lands of Europe (excluding Northern Scandinavia, which was still too cold for growing cereals). But the hunter-gatherers of the first wave forty thousand years ago –of whom we have the first palaeoanthropological records in Cro-Magnon Man– had reached a high cultural level, especially in Western Europe. This we know from the outstanding artistic activity that left us the cave paintings of Lascaux, Altamira and many others. This advanced cultural level made it possible for them to survive alongside the newly arrived farmers. The direct descendants of Cro-Magnon Man have kept up a language like no other, which is probably descended from the language spoken by the first Europeans: the Basque language.

Fourth. Farming peoples also radiated out from other parts of the world: from Central America, from Northern and Southern China, from several parts of Africa. On the Eurasian steppe, the breeding of certain animals, especially the horse, was far more successful than agriculture. The military use of the horse gave the nomadic shepherds of the steppe a considerable advantage and they probably spread into large areas of Central Asia: towards Iran, India and Europe. These peoples probably spoke Proto-Indo-European languages. About two thousand three hundred years ago, nomadic shepherd peoples of the Mongol genetic type, who spoke languages of the Altaic family, began to spread out from the Eastern steppe.

Fifth. Other expansions were deter-

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mined by innovations that have allowed navigation and trade, in the Mediterranean (Greeks, Phoenicians) or on the oceans (the Malay-Polynesian migrations which set out from South-East Asia and reached Madagascar, New Zealand, Hawaii and Easter Island).

Sixth. In the expansion throughout the world, there has been a genetic differentiation whose external features we can see in the skin colour and the shape of the body and face, and whose internal features we see in the genetic features studied so far, such as blood groups, proteins and enzymes, and the many hereditary characters that can be studied directly today in DNA, the substance contained in the nucleus of cells that is responsible for biological inheritance. Skin-colour and the shape of the face show differences between populations which are almost constant and which tell us almost immediately about the individual's ancestral origin. However, all the other hereditary features present very slight differences and only in exceptional cases can a single feature tell us if someone is of African, European, Asian or Australian origin.

The main reason is that the visible features are adaptations to different climates, for protection from the excessive sun of the tropics and from the extreme cold of Arctic and Sub-Arctic regions. For example, the small size of the nostrils and of all appendices, including the nose and limbs and the fatty deposits around the eyes in populations of Mongol origin, are adaptations to the cold of Siberia.

The body communicates with the exterior through its surface, and it is the surface that has to be modified to provide protection from the cold (or from the sun). The surface of the body is also the most visible part, and we therefore draw two impressions from it: first, that there are important differences between the races, and second, that the individuals of one race are all the same or very similar. In fact, both impressions are mistaken, because in the case of the hereditary characters that don't affect the body surface and aren't related to the climate the situation is the reverse: the differences between individuals are always greater, while those between groups, on the other hand, are slight and only detectable from the statistical frequency of the various forms in different races. The average difference between races is therefore very much smaller than one might think from the outwardly visible features that have a direct influence on our perception.

Seventh. The genetic difference between the human races is small because it has come about in a short space of time. Generally speaking, the biological difference between two organisms tends to be greater the farther back in time you have to go to find their last common ancestor. In the case of chimpanzees and us, you have to go back at least five million years, and the diversity between us and these distant cousins, although they are the animals that most resemble us, is therefore much greater than between two human races from different continents who have been separated for only a few score thousands of years.

The forces that have given rise to the difference between the races are of two types. First, natural selection, which, as I said, has produced an adaptation to differing environmental conditions. Second, there is also differentiation of a random nature, a phenomenon known technically as "genetic drift". This is greater the smaller the populations, in terms of numbers of individuals, who separated during the great migrations that spread humankind throughout the world. Genetic drift was therefore much greater in the first tens of thousands of years, when the human species lived only from hunting and gathering and populations were much smaller. The development of agriculture in the last ten thousand years has considerably increased population density in almost all the world and has greatly reduced diffe-

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rentiation due to genetic drift.

Eighth. The differences between peoples as regards social behaviour are mainly cultural in origin and not genetic, and generally speaking are therefore more easily reversible. Racism consists in the belief that the features that determine one people's superiority over another are biological in origin –in other words, hereditary and immutable. In fact, the superiority of one people over another is economic and political and always arises for historical reasons; history itself teaches us that these periods of superiority are short-lived. This should be enough to persuade us that political and economic superiority can not be put down to biological and hereditary differences. Racism is still a common social illness that needs to be eradicated.

Ninth. Cultural features are handed on by means of mechanisms we know very little about. Some of these mechanisms are similar to those that hand on genes (thus, cultural transmission from parents to children, which is frequent, though not absolute, for some features, such as those related to religion or politics). These features have a greater tendency to survive, over the course of generations, in the same way as genetic features. Other mechanisms for transmission (between non-related individuals) operate in widely differing ways and the determining features here change far more quickly with time. In the absence of high-speed communications media, of schools or of conquest by peoples of remote origin, languages are transmitted from parents to children and tend to show the same type of variation as genes do. This has made it possible to demonstrate the unexpected, incomplete but unquestionable similarity between the evolutionary history of genes and that of languages in human groups.

This is the summary of my work I wanted to make. I have had many opportunities to talk about it at the University of Barcelona, and I have had the pleasure of having several researchers from its Department of Anthropology in my laboratory for long periods. In particular I remember Jaume Bertranpetit, who, using methods we had developed earlier, has done some very interesting research on the population genetics of the Iberian Peninsula, which has subsequently spread to Eastern Europe.

It has been made quite clear that the main genetic difference on the Iberian Peninsula is the one between the descendants of the first Europeans (who today are to be found in the North West of the Peninsula and, as I said, speak mainly Basque) and the rest of the inhabitants of the Peninsula. Amongst the latter, the first to arrive in large numbers were probably the Neolithic farmers from Southern France who first occupied Catalonia and then gradually spread south across Spain. A third difference, less important than the other two, is that between the western and eastern seaboard of the Peninsula.

When more genetic data become available, we shall probably be able to find other more detailed genetic variations to which historical significance can be given. At present we are planning an international study of human genetic diversity using new molecular techniques, and the European Community has already begun to adopt it.

I am also very pleased with this award because it will only serve to strengthen my links with Catalonia. I have visited a lot of it as a tourist, from Montserrat to the medieval village of Peratallada, Pals, the city of Girona, and I have picked up a good idea of the archaeology of Menorca. My eldest son Matteo, a researcher in high-energy physics who is extending his scientific activity at Stanford, where I myself work, to Barcelona, is going to be married very soon to a Catalan artist. I therefore have every reason to thank the Catalan community for this truly exceptional welcome. Thank-you. ■