

CATALONIA, THE EUROPEAN MASSACHUSETTS. IS IT REALISTIC?*

Catalan universities and Catalan scientists

Science and technology in Catalonia and Spain are publicly funded in the main. This in itself is neither good nor bad. What is not good, however, is that such funding has always been very hard to come by. A radical change was experienced in the eighties when an unusually large amount of money was sent to those centres carrying out research and innovation. This money was put to good use by Spanish scientists who were able to demonstrate that their abilities were comparable with those in any other country, or even better. Unfortunately, today, these resources no longer meet the high level of demand created by these expectations nor support the large number of research graduates embarking on careers in research and development within public institutions. In addition to this failure of funding to keep pace with research requirements, there is increasing evidence of this imbalance which: i) cannot be good for science and technology and which ii) reflects the politicians' predilection for spin-doctoring. Unamuno's claim «Que inventen ellos» (Let them do the inventing) has been changed to: «Que inventen ellos pero que parezca que lo hacemos nosotros» (Let them do the inventing, but let's make it seem that it is us that is doing it). Nowhere is this attitude more evident than in the national Centre for Cancer research. The money allocated there is mainly for marketing. According to this, the frequent attempts to shorten the budget for this centre are not surprising. The director of the Cancer Centre, Mariano Barbacid, will have trouble in keeping the budget as originally promised by the politicians. The centre was presented to the Spanish people as the institute that will find a cure for cancer within five or ten years. In Catalonia the doubts linger but we are beginning to hear speak of centres for Bioinformatics or for Cardiovascular disease. The message from the politicians could not be clearer – with your taxes we will find a cure for cancer centre in Madrid and all types of problems will be eradicated with the Bioinformatics and Cardiovascular centres in Barcelona –in their attempts at cheap electioneering. The move to increase investment in scientific research from 1% of the Spanish GDP to 2% is not only a good idea but absolutely essential. However, the allocation of this increased funding to marketing centres or to military re-

search, such as the investment of millions of dollars of the tax payers' money for the construction of an experimental plane that crashed, 30 seconds after take-off, is, quite plainly, wrong. The money cannot be allocated on the basis of a scientist with a well-established reputation being recruited from the States, or of a «crack squad» of scientists being set up artificially or by lobbying, nor can it be allocated on the principle of being in the right place at the right time, i.e. contacts with a politician, or as a result of lobbying from the military sector. Despite being a pacifist, I can understand that some of our taxes must go towards military research and development, but what is not tolerable is money being wasted on madcap schemes proposed by unprofessional military or aeronautic engineers.

This article will focus on the field of Biomedicine, the field in which I am engaged, and a field of recognised excellence in Catalonia and Spain. It is my contention that this field has an enormous potential for development where development is understood to be not only publication in the journals of greatest prestige but also the generation of income from the development of new compounds, new therapies and new methods of diagnosis. I strongly believe that in this field the current spin-doctoring policy of our politicians acts as a hindrance to optimal development in Catalonia and Spain as we enter the new Millennium. Below, I shall try to demonstrate why this is the case and propose alternatives so as to reap the greatest benefits from the scientific and socio-economic output.

As the reader is no doubt aware, biomedical research in Spain is mainly undertaken within the Universities, including University Hospitals, and by the Spanish Science Research Council CSIC: Consejo Superior de Investigaciones Científicas). In Madrid the number of centres belonging to the CSIC is comparable to that of centres conducting research at the Universities. In the rest of Spain, including Catalonia, this is not the case and, despite the importance of the contribution of the CSIC institutions in Catalonia, here I shall centre my discussion on the Catalan Universities.

If you are still wondering about the comparison drawn at the beginning of this article between Catalonia and Massachusetts, according to a highly respected report the leading university centre for basic biomedical research is the Department of Biochemistry and Molecular Biology at the University of Barcelona (UB) and the leading centre for Clinical Research in Spain is the Hospital Clinic, which is the University Hospital of the UB. This is sufficient proof that Catalan scientists working in the field of biomedicine are among the best in Spain. If we examine their scientific output, measured

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in terms of number of articles and the impact factor of the journals in which these articles are published, it is also evident that Catalan scientists conducting research in biomedicine meet international standards of quality and production.

The struggle facing Catalan scientists

The claim that we are better than our counterparts working in other countries is often denied by Catalan and Spanish scientists fearful of appearing smug and self-righteous. A certain degree of self-righteousness is, however, necessary to enhance the social recognition of any group or community, though in this particular case there is strong evidence to demonstrate the veracity of the claim.

In our society, scientists are engaged in a war, the origins of which can be traced to the fact that politicians decided to create the university in the image of its own civil service. This means that university professors are mere functionaries. In Catalonia and Spain this has meant the creation of a considerable stumbling block since the only way of becoming a tenured lecturer (*professor titular*) or professor (*catedràtic*) is by means of a competitive examination (*oposició*), which is the same process to obtain any post in the civil service. The *oposició* to be sat in order to become a professor includes 2 oral presentations which are evaluated by 5 professors, 2 of whom hold posts at the same university and 3 that are selected at random from other universities. Conflict is guaranteed when a local candidate with considerable lecturing experience and with a good research record finds herself in competition with another candidate with no lecturing experience but with a better research record because he has just completed post-doctoral research in the United States. Irrespective of who is the winner, such conflict is quickly transformed into dissatisfaction and loathing of the system and all it entails.

With few exceptions it is usually the case that both candidates deserve the job. Indeed it is not uncommon to hear it said that it is easier to be an Assistant Professor in Harvard than *Professor Titular* at the UB. In the field of Biomedicine, the local candidates undisputedly boast excellent CVs and the successful candidates returning from a period spent working abroad take some time to adapt to their lecturing duties. Typically the assessment ratings from their students are poor while their research suffers from the other burdens on their time and the lack of resources. Even highly rated scientists at Harvard suffer a marked deterioration in their job performance on becoming a *Professor Titular* within a Spanish university.

The assumption that here in Spain «cronyism» (an expression used time and time again by the journal *Nature* when describing Spanish science and Spanish scientists within the country's universities) is the favoured system by which jobs are obtained could not be farther from the truth. Indeed all those who hold this assertion to be true (and this includes *Nature*) offer little comfort to science and scientists in Spain. As a matter of fact there are always voices sug-

gesting that the way to solve this problem is to include 4 or even 5 external examiners on the selection committee. Could you imagine Harvard appointing 4 members from Yale, Stanford, etc., in order to select their professors?.

It would, however, be a good idea to solve the conflicts that arise out of the competitive nature of the system because such conflict is ultimately only detrimental to the scientists themselves. While fighting and arguing among ourselves we are failing to put the necessary pressure on politicians (and they are well aware of this!). It is my belief that we need greater opportunities outside the publicly controlled circles in which science is being performed, i.e. more companies need to be brought up-to-date and to be made aware of the benefits to be gained from undertaking R+D. This would mean contracting more post-doctorate researchers and the establishment of close working relations with the universities. The main weakness of a system based on the *oposició* is that, apart from the blow to the morale of the losing candidate who despite being an excellent scientist misses out on the post, it is difficult for the loser to find work outside the publicly controlled circles. We are fortunate in this respect that some hospitals have realised the importance of conducting research and they are contracting well trained post-doctorate researchers to direct basic but clinically-oriented research. But what is also needed is that the companies located in Catalonia carry out more research, while biotech companies are set up as joint ventures so as to turn to our advantage the expertise of these scientists.

The assumption that the Professors at a Catalan University are lucky for having successfully passed one (*professor titular*) or even two (*catedràtic*) *oposicions* is quickly undermined if we examine the situation at universities elsewhere in Spain.

A colleague of mine, a professor at the UB, frequently comments that we must be stupid to be doing this job because our counterparts in France, Germany and Italy are earning considerably more. This means that those of us working in Biomedicine must be even more stupid since we work more intensely and put in more hours than those working in most other disciplines yet we receive the same salary. What's more, our stupidity knows no limits as we choose to work at a Catalan University. At the University of, let us say, Castilla-La Mancha, a *catedràtic* is somebody, a post carrying considerable prestige in the community. At the University of Barcelona a *catedràtic* is not very different from anybody else, while what cannot be denied is that the salary of a Professor has a much higher purchasing power in Ciudad Real than it has in Barcelona. My colleague adds that to cap it all we had to go and work in a Department that gives more than the average number of lectures per year.

My colleagues' frequent gripes nevertheless are illustrative of the situation that the Catalan scientist must face. A number of points need highlighting:

–One: We cannot abandon the race to be the leaders in our profession and this requires many hours of work in the laboratory, in the office, in the lecture room and, inevitably, at home. The question is though what is to be gained from all this effort. We receive some recognition, mainly from the out-

side and very little (or none at all) from the Institution itself and the Catalan Government. What we most certainly do not get are higher financial rewards in terms of a higher salary. In fact further proof of our stupidity is that our «product», which is essentially an article in a prestigious journal, gives us no monetary gain at all. Architects or journalists are paid for their reports but this is not the case for scientists.

–Two: We are given no administrative or technical support. In addition to leading the world in terms of the number of lectures given per year, we are also leaders in the table of the lowest expenditure on secretarial support. I am a *cate-dràtic* without a secretary, and I am not the only one. I do not know of any other professor in any part of the world (the Third World included) who does not have a secretary. The same is true of technicians or post-doctoral researchers. Today it remains a «luxury» to have a technician or a post-doctoral researcher. Admittedly, some groups do have technicians but these are the exception and where they exist they are paid almost exclusively from contracts with companies or it is wangled somehow or other. The provision of technical support should go hand in hand with the awarding of a research grant, that is the salary of the technician should be included within the financing provided by the grant, as is the case in the States and in many other countries.

–Three: It is hard to obtain financial backing. Though it is relatively easy to find some financial support for projects headed by a respected scientist, it is very difficult to find all the support needed in order to compete with the best. In 1999 I applied for nine grants and was only awarded two –the safe bets from the Spanish Commission of Science and Technology and its counterpart in Catalonia. This experience, apart from causing me to fall into a deep depression, taught me that Catalan, Spanish and European science policies must change for the good of European science. Governments must value our work in financial terms. The financial losses incurred by European scientists not being awarded grants are very high; I have estimated the value of the hours lost by European Scientists at something around 70 million *euros* per year. This is quite unacceptable and does not happen at all in the States.

–Four: We devote too much time to meetings. Since the democratisation of the University structure we are always in meetings. The numbers attending such meetings are usually too high. Thus before any decision can be taken many arguments have to be listened to. But on top of this the administrative structure of the universities –from the Ministry or Ministries in Madrid, to the respective *Conseller* in Catalonia, to the Rector, or to the Head of Division of the University –is not designed in such a way as to ensure that the decision making process can operate smoothly and swiftly. Routine matters require time for approval but this is usually granted in a period of 2 months. However, anything not of a routine nature, any innovation, requires month after month of talks and hundreds of meetings before any progress is made and even then the project is far from being perfect or complete, i.e. the «administrative» requirements are clear but the operational approach has yet to be considered. An example of

this is the current buzzword being used at all levels of the University – «Quality». After a number of discussions it is agreed that we should be offering «quality», but little is known about how we should proceed in understanding what lies behind the term let alone in improving the quality being offered. Needless to say, there is very little money to implement the program.

In short, the science being undertaken in Catalonia is comparable to that being carried out in institutions of repute throughout Europe and America because we are prepared to make that additional effort and not because we are able to work in suitable facilities or in a suitable environment. I am not sure whether I would be able to convince my colleagues on this point but for me this is irrefutable evidence that we cannot claim to be good professionals of the world of science. We have the necessary capabilities but we cannot accomplish good professional standards. We cannot be good professionals if we devote part of our time to giving so many lectures, to writing all our letters, to putting the articles inside envelopes and to attending a multiplicity of meetings (from the academic, to the scientific, to the simply irrelevant), etc. Several responses, albeit of a personal nature, can be made to this situation. One response, indeed one that I used to condemn but not anymore, is to give good lectures and simply to do what one can in what is left of the 40 hour working week. In fact the Universities only pay us to give lectures. If we also undertake research it is because we want to do so; we are under no obligation. Other responses are possible but things must change before we can conduct research in good conditions and gain recognition for doing it well. It is extremely dangerous that Catalonia only gives recognition to an «elite» group of researchers. I will turn to this point below. Today in Catalonia (and in Spain) this «elite» is not only composed of people publishing in the leading scientific journals but of people who have learnt how to lobby successfully or those who work in areas that are in vogue or considered politically advantageous. What I am arguing for is not that everyone should have a slice of the cake but simply that more money needs allocating to guarantee the work of competent scientists in Catalonia.

We, the scientists of Catalonia, are guilty of not putting into words what we really think. We must make ourselves heard. We must also work together to ensure that the politicians allocate more money to science and technology, not in the form of prizes or other contrivances, but as financial support to meet the needs of competent Catalan scientists. When we achieve this it must be on the understanding that we must be able to capitalise on it. In other words by working in better conditions and having more time to dedicate to our research, our findings can be put to the greater good of society.

The struggle facing Catalan universities

With the exception of the Pompeu Fabra University, which is widely perceived to be a private university and which is the

recipient of more public money than the other universities, the Catalan public universities do not receive enough money to cover the needs of a modern university in the new Millennium. In this respect, the situation mimics that of the Catalan researchers. In the last 20 years Catalan universities have undertaken the enormous task of modernisation in order to compete with universities around the world. Although this has not been an easy task, Catalan Universities have entered the new Millennium in a healthy position. In terms of research our Universities are comparable with the best universities in Europe frequently performing better than their German counterparts. Unfortunately, this modernisation requires a level of financial backing that neither the Spanish nor the Catalan Governments are prepared to provide. Below I will argue that this is due, in part, to a lack of awareness on the part of the Governments but also to the universities inability to demand adequate funding.

By way of the press, it has been announced that the University of Barcelona has a deficit in the budget for year 2000 of 1,000 million pesetas, due in the main to research-related expenditure. Although the University of Barcelona is the foremost university in Catalonia, the Catalan Government has, to the best of my knowledge, expressed little concern about this deficit. The Vice-Rector with responsibility for the finances and the organisation of the UB, Enric I. Canela, has written about the problems that a university that performs excellent research necessarily has to face. Here again the Catalan Government has, to the best of my knowledge, attached small credence to the opinions of the Vice-Rector. The argument of Enric I. Canela is clear: a university performing high quality research loses money. Put in other words: a university performs better in economic terms if it does not undertake research. This apparent paradox is easily explained. A university undertaking high quality research needs to provide an adequate infrastructure for this work: i.e. the necessary equipment and facilities, both of which require maintenance and renewal. This, together with the bill for water and power is an added obstacle for the university performing well in science. This situation at the beginning of the new Millennium is simply intolerable and yet there is no perspective of an immediate solution being offered. This is clearly not good for the University and compromises all the excellent research being undertaken within the UB.

Enough overheads?

Can the deficit caused by research maintenance costs be covered out of overheads? In theory this is the reason grants given to researchers are accompanied by so-called overhead charges. This is the percentage (10-15%) paid directly to the university where the researcher performs his work. In my opinion many of the problems concerning the viability of research could though be solved by increasing the overheads. It is the responsibility of the Catalan Universities and the Catalan Government to be able to obtain from the funding sources, mainly the central Government and

the CICYT, the right percentage of overheads for each university.

The University of Barcelona for instance has set up a team that can construct statistics of all the research carried out at the University. The team has even developed a method of evaluating the research work, which has attracted the interest of the Ministry in Madrid. Although the method is not very reliable when comparing individual researchers from the same or different fields, the method is particularly useful for evaluating groups of researchers. Thus, a comparison of the work of Rafael Franco with that of another researcher would not give a valid picture, but a comparison between the work of the whole Department of Biochemistry at the University of Barcelona and that of a similar Department at another university gives reliable results.

Given this possibility to compare research, these statistics should be used by institutions housing good research centres in order to ask for a higher percentage of overheads. The quality of work performed at Harvard is not only the result of the quality of its researchers but also due to the quality of its facilities. This is the reason overheads at Harvard University stand at 65%, i.e. for every 10 million given to a researcher, 6.5 million goes to the Institution; therefore, the granting agency is giving a total of 16.5 million to Harvard. Currently the percentages given to Catalan universities are the same as those given to any other university in Spain. They are in the range of 10-15%. Given the clearly ridiculous level of overheads, the opinion of the Vice-Rector of the UB needs no further comment: «there is a lack of correlation between the money the University receives and the activities that the University must undertake with it».

Can the Catalan universities be for Europe what the universities of Massachusetts are for the States?

I think we would have to agree that this is already the case, i.e. that the position of the Catalan universities in Europe is comparable to that of the universities of Massachusetts in the USA. In biomedical research and in many other areas, Catalan universities perform very well and lead the European universities. Thus, the situation is comparable to that of the universities located in Massachusetts. The University of Barcelona has the highest ratings in many research fields in Spain (e.g. biomedicine and Spanish literature) and is among the top universities in Europe. Catalonia is home to other universities that are rated above average in Europe. These universities should not be overlooked in the same way that the other universities in Massachusetts cannot be forgotten: Boston University, Northwestern University, Brandeis, Tufts University, etc.

Interestingly, the reasons why the universities in Massachusetts rate so highly differ considerably from the reasons why Catalan Universities rate so highly in Europe. Perhaps the best way to explain these differences is by means of a sporting analogy. Let us compare basketball teams from Catalonia (Joventut de Badalona or F.C. Barcelona) and the

best team in Massachusetts (the Celtics). The two Catalan teams are among the best in Europe, while the Celtics are among the best in the States. What distinguishes these teams from each other? I think that we can sum up these differences by stating that the Celtics are professionals whereas the Catalan teams are semi-professionals. The financial structure and organisation and the players' salaries lie at the root of the differences between fully professional and semi-professional teams. One last point: the Celtics make a profit whereas Catalan teams do not.

At the heart of the argument lies the question as to whether Spanish and Catalan society wants to invest in the quality research being produced by its scientists. A look at the current policies being implemented by the Spanish and Catalan Governments would suggest not. It is high time those in government began to consider whether they want to invest and obtain revenue in the form of scientific and technological innovation or whether they would prefer to invest less money and only obtain revenue in terms of increased electoral support.

The recently appointed *Conseller* of Universities, Research and Information Society, Andreu Mas Colell, has worked at Harvard. Therefore, he more than most knows that the human capital within the Catalan Universities is similar to that in Massachusetts. It is quite probable that Andreu Mas also knows that Catalan society does not want our Government to invest our taxes solely in spin and the winning of votes. On the contrary our society is well aware of the need to invest so as to increase our GDP and the number of jobs being created. The Catalan Government, represented by the *Conseller* Andreu Mas, should act accordingly, i.e. by allocating considerably larger sums for research purposes in Catalonia and by asking Spain (and even Europe) for more money for Catalan Universities. It is much to be done in lobbying, from Catalonia lobbying in Spain and directly in Brussels, to Spain lobbying in Brussels. The Catalan and Spanish capacity of lobbying is quite poor and it does not seem that there is the intention to change this trend. I am referring to lobbying in national and European science and scientific forums, which is absolutely fundamental to satisfy the needs of us, the scientists.

This is not the moment to ensure that everyone gets to eat their slice of the cake, but neither is it the moment for self-promotion by means of the awarding of prizes or the allocation of money to big centres, whose main asset is to have a marketable name. A successful and sociably profitable scientific and/or innovative centre can only be created by a synergism of what is already pre-existing in a given society. This means that a centre of excellence (scientific, social and economical) can only come up when a critical mass of scientists working in areas of excellence are put to work together. These centres have to integrate scientists, Spanish or foreigners, coming from other Regions or Countries, but cannot be artificially constructed on the shadow of a single scientist, no matter the prestige that he/she has.

The human potential of Catalonia is our most valuable asset for the furthering of scientific research. A typical career for a good Catalan scientist includes the earning of a doctor-

ate from a Catalan University, a stay abroad (preferably in the States) for 2 or 3 years and then a return to a Catalan university. It is difficult for those who stay too long in the States to adapt to the Catalan and Spanish university system and our way of conducting science. This does not mean that these researchers have nothing to offer, though in general terms the relationship productivity/money for such scientists is usually lower.

For this reason if the Catalan Government wants to create new Research Centres it must back those research fields of excellence that are performing well in Catalonia. In such centres synergism will automatically appear when different research groups working in the same area, as well as scientists from complementary areas, meet and interact. The model of artificially creating a large structure under only one scientist, regardless of whether he or she is famous, does not happen at Harvard or in any other large institution in the world. There is also room for large projects, with international repercussions, but again the Catalan Government should consult its own scientists. What is clear is that the advisers to the Catalan Government have come up with few good ideas over the last 20 years. It would appear that there is a strong need for a project management office within the organisational structure of the *Conselleria* of Universities, Research and Information Society. This could coordinate and facilitate research in areas of excellence and propose to the Catalan Parliament ambitious yet feasible projects.

The universities must though take advantage of the extra money entering the system by means of suitable overhead payments. Catalan Universities must establish overheads from a minimum of 30% all the way up to 60%. Overheads would depend on the quality of the university and on the quality of the scientific field (be it biomedicine, Spanish literature or psychology). Ideally these overheads would be met by the institution awarding the funding. However, in those cases where the grant could not meet the overhead requirements, the Catalan Government would make good the difference. This would give less versatility in political terms but this is not necessarily negative. If some of the money is allocated by the *Conseller* automatically the structure of the *Conseller's* Office would be smaller and, therefore, cheaper. This means that the *Conseller* would lose some financial powers, but at the same time it should lead to a gain in efficacy and allow the *Conseller* more time to think globally and to establish a genuine policy in Research and Higher Education, something that has been sadly absent since the advent of democracy in Spain.

Can Catalan scientists be for Europe what the scientists of Massachusetts are for the States?

As we have seen it is little wonder that Catalan scientists are not as professional as their colleagues in Boston or in Cambridge. In order to narrow the gap what we need are better salaries, a better organisational structure and more funding and facilities for research.

Scientists at Harvard earn higher salaries and enjoy better working conditions than their colleagues in Kansas for example, yet Catalan scientists earn, in comparative terms, less than colleagues in Galicia or Murcia. To understand this we simply have to consider the price differences regarding housing and transport. All this demonstrates the fact that the Catalan Government does not value our work. There is no other possible explanation. Thus while Catalonia, together with the region of Berlin, heads the regions with the fastest economic development in Europe, Catalan scientists are losing their purchasing power with each passing year. If we take inflation into account, our salaries have fallen by more than twenty points in the last ten years. Poor salaries and the decline in working conditions both in the conducting of research and teaching have resulted in 250 professors from the universities of Catalonia signing a petition that was sent to all political candidates standing at the elections for the Catalan Parliament in 1999. It is telling that not one of the candidates replied to the petition. More recently this letter was sent to the newly appointed *Conseller*, Andreu Mas. To date no response has been given.

What is particularly striking is that whereas politicians in Catalonia can demonstrate this lack of sensitivity, the Governments of nine other regions (*Comunitats Autònomes*) throughout Spain are either paying a bonus to the salary of their professors or are in the process of introducing legislation to do so. No such initiative has been taken by the Catalan Parliament and it is doubtful that it ever will unless Catalan scientists give voice to their grievances.

This lack of response in Catalonia reflects the complete absence of understanding of what is rapidly deteriorating into a serious problem and the politicians sole concern for the aspects of science and technology that further their own interests. Politicians only speak of science to gain votes, not because they value Catalan science or Catalan scientists.

I wonder whether politicians, be they in government or in opposition, can be convinced that Catalan scientists are a good investment. However, to convince them of our potential we first need to be recognised and even then, we still need: sufficient resources, sufficient equipment, sufficient human potential and a decent salary for everybody working full-time (teaching plus research) for the university.

We should not forget that Europe, in general, and Spain and Catalonia, in particular, trail the States in the amount of

joint venture capital being made available for science and technology. Apart from the need for stronger links between industry and the universities, the flow of money provided by joint ventures and is essential. The politicians in Europe fail to understand that the most innovative and potentially profitable projects cannot be financed out of public funds or by established companies. Such projects require money from joint venture capital or, eventually, specially created Foundations, as this is the only way to achieve a profitable high value product or process. This requires a change in the laws and a change in the thinking of European investors.

We, the scientists, should stop fighting among ourselves and start putting pressure politicians and on our society in order to obtain what we need. We, in turn, should be quite clear that in return for a decent salary and adequate funding and a suitable working environment, we have to maximise the profit on the money our society invests in our work and in our ideas.

In summary

It is my belief that Catalonia boasts a human potential on a par with that of the state of Massachusetts and, similarly, that the potential of the University of Barcelona is comparable to that of Harvard University. Science and innovation in Catalonia, however, do not enjoy the backing of government bodies (at any level from the EU down to the Autonomous Government of Catalonia) nor that of companies and private foundations. Spanish and Catalan politicians consider science and technology as simple tools of marketing while EU politicians have yet to establish an effective model for funding and reaping the benefits of European science. In contrast to what is generally believed, many Catalan companies are still rooted in the practices of the XX century whereas, in contrast, there are many departments in the Catalan Universities that are constantly incorporating the very latest technological developments. If we wish to get the best out of the science being undertaken in Catalonia, this will require a radical change in the policies being implemented from Brussels, a radical change in the thinking of Spanish and Catalan politicians and the overhaul of Spanish and Catalan companies; it will also require a change in legislation to facilitate the large scale funding of projects by private foundations and joint capital ventures.