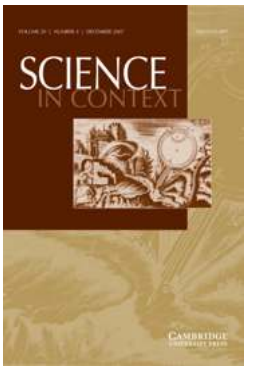

"Of sea urchins, volcanoes, earthquakes … and engagement": Marcello Carapezza, Alberto Monroy, and Italy's University System

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"Of sea urchins, volcanoes, earthquakes . . . and *engagement*": Marcello Carapezza, Alberto Monroy, and Italy's University System

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Argument

In Italy, only 2 per cent of the population consider scientists and experts to be society's leading personalities (Censis 2006). Scientists are classified among the "weak social groups" and more precisely as those who have little influence either because they lack representation in the media (the faculty), or because they lack resources. (Young researchers face the lowest percentage of GDP invested in research among the G8 countries.) This article contributes to the current debate on science policies in Europe and addresses the question of why science has such a low reputation in Italy. How did this situation emerge and what methods should be taken to tackle it beyond merely increasing financial resources? An historical overview of how Marcello Carapezza and Alberto Monroy created leading research centers in geochemistry and developmental biology in Palermo offers insight into the opportunities and threats posed by Italy's academic system. This brief analysis of the Italian academic system should interest international readers who want their country to evolve from a closed, corporative, centralized system into a country that can compete at an international level to attract talented students and resources and achieve a higher scientific reputation.

The practice of scientific research in Italy is becoming increasingly difficult. Many of the best graduate students in southern Italy and the richer northern regions leave the country permanently (Becker et al. 2004). Even more discomforting is the absence of foreign researchers in Italy's universities. For instance, foreign Ph.D. students in Italy in 2000 amounted to only 2 per cent; whereas one-third of the Ph. D. candidates in the United Kingdom and one-quarter of them in the United States are foreign, while Portugal attracts a percentage of Ph.D. candidates from foreign countries six times higher and Spain three times higher than Italy (see first row in Table 1 of Gagliarduggi et al. 2005). In principle, foreigners who speak Italian can apply for professorship, but in practice there are almost no foreign faculty and a tiny minority of academics from Europe's former socialist countries who left for reasons of poverty and isolation.

The economic analysis cited (Gagliarducci et al. 2005) clearly demonstrates that it is not the scarcity of financial resources (even if the public budget for research in Italy, 1.1

Table 1. International Mobility of Brains

Country	% Ph.D.s Foreigners	% Foreigners at work in S&T[1]	Brain Gain from EU[2]	Brain Drain towards EU[3]	Brain Drain towards US[4]
USA	26	10	n.a.	n.a.	n.a.
German	n.a.	4	84,500	25,400	30
UK	35	4.2	42,400	30,900	20
France	n.a.	3.5	32,700	26,000	31
Italy	**2**	**1.0**	**3,300**	**34,400**	**41**
Spain	11	1.5	3,500	16,900	21
Portugal	6	n.a.	1,000	8,900	12

Note: Data of year 2000. Source: European Commission (2003). [1]Percentage of foreigners occupied in science and technology. [2]Number of citizens working in science and technology (S&T) coming from another EU country. [3]Number of citizens in S&T emigrated to another EU country. [4]Foreign researchers in the US every 1,000 researchers in the country of origin (1999).

per cent of GDP, is lowest among G8 countries), but rather the absence of the merit criterion in the allocation of such resources that accounts for such a low achievement.

Students complain about absenteeism of their professors and the lack of mentoring during their studies. Proliferation in the number of public universities (82 as we write this article); the absence of an independent evaluation system to assess the quality of research and educational work; and rules that guarantee a permanent position to university professors and researchers in public research bodies regardless of their contribution to scientific production and teaching – all are factors ensuring that no change will take place unless rules are changed and new regulations based on merit are enforced. As the failed reforms of the 1990s clearly demonstrate, increasing the budget without introducing any incentive that rewards merit and scientific productivity would not produce any improvement (Perotti 2002). The process of selection and promotion of researchers and professors at both university and public research centers is flawed by cronyism and nepotism. News reports of arrests and police investigations of university selections of research personnel have become normal. For example, in 2005, just while Italy's university rectors were claiming the need for a larger budget from government, a university president was forced to resign after he was accused of nepotism in the selection of a researcher (Selvatici 2006). Statistical data on the scientific productivity of Italy's researchers can be properly compared with other countries and can be understood only when put in context (Forman et al. 1975). Moreover, quantitative evaluation of science in terms of number of papers and, more recently of scientific journals, and in the impact factors, is certainly not enough (Nye 1984). Yet, the results in Table 2 offer a clear picture of the current situation. Global scientific productivity of Italy's scientists (data of columns 1 and 2 in Table 2) seems encouraging. However, the number of academic researchers in Italy and in southern European countries is among the largest

Table 2. Productivity and Quality of Italy's Researchers

	Publications/ Researchers *1*	Citations/ Researchers *2*	Academic researchers/ Total researchers *3*	Publications/ Academic researchers *4*	Citations/ Academic researchers *5*	Impact factor (*mean*) *6*	Impact factor (*standardized*) *7*
USA	1.00	8.60	0.15	6.80	58.33	8.57	1.48
Germany	1.25	8.64	0.26	4.77	32.98	6.91	1.33
UK	2.17	15.86	0.31	6.99	51	7.30	1.39
France	1.45	9.43	0.35	4.09	26.68	6.52	1.12
Italy	**2.26**	**14.81**	**0.38**	**5.88**	**38.57**	**6.56**	**1.12**
Spain	1.68	9.09	0.55	3.06	16.54	5.41	0.97
Portugal	0.86	3.99	0.52	1.65	7.62	4.62	0.82
Denmark	1.96	15.57	0.30	6.50	51.56	7.93	1.48
Netherlands	2.29	18.79	0.31	7.41	59.58	8.20	1.39
Canada	1.68	11.79	0.33	5.04	32.28	7.00	1.18

Standardized IF = IF/; Source: King (2004); Period: 1997–2001. Number of researchers: OECD, Main Science and Technology Indicators database, 1999.

(column 3). These researchers for obvious reasons publish far more papers compared to their colleagues in industry. Hence, when the number of publications and citations per academic researcher is considered (columns 4 and 5), Italy lags behind not only the US but also behind UK, Holland, and Denmark.

In line with these data, column 6 shows that in the impact factor, i.e., the ratio between the citations of papers published in the 1997–2001 time span and the number of said publications, Italy is ahead only of France, Portugal, and Spain. Furthermore, as the trend in citation varies with the discipline, it is useful to standardize discipline's impact factor relative to the international average (shown in column 7). In this case, too, Italy is only ahead of Spain and Portugal. According to Thomson ISI Essential Science Indicators Web analysis of 2006 covering an eleven year period (January 1995 - February 2005) among the 140 top-performing countries in all fields, Italy ranked #7 for citations, #7 for papers, and #27 for citations per paper.

In 2005 the first research assessment was carried out by a government organization (Civr). However, this evaluation was not used to allocate resources according to merit. Moreover, the parameters used by Civr did not compare the scientific results versus the financial support received by the funding agencies. The ranking would probably change significantly when considering this parameter, whereas a well organized merit system should highlight and encourage single emerging scientists rather than "schools" of scientists, an attitude that accounts for the inbreeding that is widely present in Italy's system.

In this article, I aim to analyze the cause of both low performance and lack of attractiveness in Italy's higher educational and research system. I will tell the story of two great Italian scientists of recent past who were able to create international

schools and also play a public role that went beyond the boundaries of their disciplines. The scientists are the founders of Palermo's developmental biology and geochemistry schools, Alberto Monroy and Marcello Carapezza, who operated from the 1950s to the mid-1980s. Successful research communities often flourish in unexpected places because of unique combinations of local and transient conditions and circumstances. This paper does not aim to fully address some of the other factors that may have inspired fruitful research innovations in Palermo during this period. Certainly, we must note that an unprecedented number of artists (Renato Guttuso), writers (Leonardo Sciascia), publishing houses (Sellerio, Novecento), journalists (Vittorio Nisticò and his team at the evening's newspaper *L'Ora*) and innovative politicians (Piersanti Mattarella) were all active in Palermo and were interacting during those years. For instance, Leonardo Sciascia and Renato Guttuso jointly wrote essays with Carapezza himself.

I will describe how these researchers created international schools of great renown in the second poorest region of Italy in spite of the obsolete rules and lack of incentives that are still present even today (Perotti 2002). We believe that such an overview will be useful in guiding young scientists to reverse the "brain drain" phenomenon and make their research centers in Italy attractive to talented local and foreign students.

Marcello Carapezza graduated in chemistry from Palermo's university in the late 1940s. Like most of the city's institutions, the university was in shambles due to the turmoil in Europe during World War II. Heavy bombings from the United States and Royal Air Forces had half buried Palermo in 1943 (D'Este 1988). A scientific school that had been started by Stanislao Cannizzaro, one of the fathers of modern chemistry, and had recently hosted the future Nobel Prize in physics Emilio Segrè (who co-operated in Palermo with Carlo Perrier to isolate the novel element 43), was practically demolished.

Carapezza, a native of the mountain village Petralia, studied chemistry and worked for a while at the Institute of Mineralogy led by Professor Perrier. Soon afterwards, he moved to Pennsylvania State University where he learned the novel and experimental high-pressure and temperature techniques employed to study multiphase rock systems. There, building on the work of geochemist Hans Eugster, Carapezza discovered that the oxygen partial pressure in a solid solution is a linear function of the relative composition: a fundamental finding for the study of rocks, and thus of any geological system, including planets (Carapezza 1966).

In 1959 Carapezza joined the faculty of Bologna's university as assistant professor and spent ten fruitful years establishing contacts that proved to be useful upon his return to the University of Palermo where he held the chair of applied geochemistry from 1970. Back in Sicily, Carapezza changed his research interests to what his lifelong friend and colleague Marco Leone calls "the relationship of man and nature": a research topic that was emerging at a time when the first effects of the intensive human activities on nature were becoming disappointingly clear (Leone 1998). Hence, he started to carry out research that could be applied to such environmental problems as degradation of monuments due to atmospheric pollution. He also did research that could be applied

to geochemical surveillance in order to protect citizens from earthquakes and volcanic eruption.

According to Leone, a professor of mineralogy now retired, "his objective was the creation of a modern, reliable scientific system for the problems of civil defense in Italy." Carapezza found support from Italy's Research Council (CNR) which agreed to finance his efforts by launching first the finalized project "Geodynamics" (a multi-participant research program which became instrumental in realizing the permanent monitoring system in question), and then enabled Carapezza to found the new Institute of Fluids Geochemistry (IGF).

The finalized project had among its main objectives the evaluation of seismic and volcanic risks in Italy. Despite a history of terrific earthquakes and volcanic explosions – including Pompei's destruction in 76 B.C. and Messina's devastating earthquake in 1908 – Italy's law in 1976 still absurdly prescribed that a region had to be the site of an earthquake in the twentieth century in order to be considered seismic. This law excluded the plain of Catania, for example, although it was well known that earthquakes in the whole plain below Mount Etna were extremely likely, as proved by the city's destruction in 1683 and by the similar burial of Messina (70 km north of Catania) in 1908. Carapezza recommended that the government adopt a classification of territorial seismicity, historical *and* statistical, that would count the Catania plain among the most risky places in Italy. He and his colleagues had not even completed the report of the project "Geodynamics" when, on November 23, 1980, the Irpinia earthquake, which caused 3,000 deaths and damages for billion dollars, revealed how seriously obsolete and inadequate the Italian civil defense system was. Parliament soon adopted the new geological map of risk and drafted new legislation that was enforced a few months later.

Carapezza acted according to Voltaire's prescription for intellectuals to live in their own times, and was a member of the governmental Commission "Great Risks" of the CNR's Volcanology Group. He was the first chairman of the committee "Earth Sciences" of Italy's Ministry of Education whose goal was to reform the teaching of geology in high-schools. Educated in classic thought and its timeless value at Italy's high-school *Liceo* (created by another famous Sicilian, Giovanni Gentile), Marcello Carapezza was a renaissance humanist. "A world without myths," he wrote, "is a world without ideals." This attitude can be seen in his reviews of Pirandello's novels and his criticism of the paintings of his friend, the painter Renato Guttuso.

Professor Carapezza was a frequent contributor to magazines and newspapers. The university always rewarded his outreach efforts, since it suffered from the marginality typical of all Sicily's institutions. He brought Sicily to the attention of the culture and chronicle pages of Italy's main newspapers for matters that had nothing to do with the mafia criminal affairs that are usually reported in Italy's press. In 1983, for instance, he attracted national attention during one of the worst recent eruptions of Mount Etna, the volcano dominating Catania, where – exactly as in the Naples suburbs below the Vesuvio – entire villages were built in high-risk zones in flagrant abuse of the

law. According to urbanist Antonio Cederna the best choice was self-evident, namely to leave the volcano erupt quietly and let the lava "destroy what it had to destroy." Carapezza did not agree and wrote an article entitled "Man and his Business: Survive" in the newspaper *Giornale di Sicilia*:

> The deviation of the lava flow on Etna provoked the reaction of various ecologists. . . . The articles of Giovanni Maria Pace and Antonio Cederna have shown the basic error of their reasoning . . . to ignore man. Man does and can not exist in this abstract, perfect ecology imagined by Cederna. Because man provokes damages everywhere: whether he tries to protect the environment or plants vineyard, orange groves or olive trees in places where before Mediterranean brush grew
> This should be called: *anandrecology*, ecology without man!
> I confess that I was surprised to hear that the hollow in which the lava flow should be deviated is considered for the vegetation one of the "rarest and most important environmental heritages." I went there and examined it inch after inch: The only species growing was a variety of thorns called by botanists *Astragalis siculus*, and commonly known as Holy thorns; one of the few plants which manage to grow on every type of volcanic rock at high altitudes, and which is present everywhere above a certain quota on Etna.
> To think that today we can do something to prevent the damages caused by the lava flow and not do it, is the most backward statement I ever heard in many years. In this way, we should continue to respect nature: What is for instance the duty of a wet clay formation on a slope? It is clear: It should slide. And anything that may stop it is "human arrogance." On one side, the experiments, and an attempt to find an explanation and to forecast and prevent, putting man before anything else. On the other side, an exhortation to do nothing.

A few days later, Carapezza and Barberi were authorized by the government to blast the volcanic lava with military explosives, which they did with the assistance of the Italian Army. They were successful in diverting the flow of the lava away from the city Nicolosi using a method that, when applicable, is used today by the geological services of several countries worldwide.

Professor Carapezza also had rare management skills. Between 1972 and 1984 as the university vice-chancellor he conceived of the restoration of the old, splendid palace "Steri di Chiaramonte," and called on the great Italian architect Carlo Scarpa for the restoration project. Eventually, in 1985 the rectorate of Palermo's University was moved to Palazzo Steri; and thanks to Carapezza, Renato Guttuso donated his painting "La Vucciria" to the university and it is now on display in its rectorate.

When Carapezza witnessed the progressive deterioration of Italy's main scientific institution, its universities, he wrote: "It is not possible that a nation owning cultural heritage that is one of the richest in the world should disappear from the universal scene of knowledge because of unsupported claims which aim to level out values and humiliate merit" (Carapezza et al. 1984). When he died in September 1987, Marcello Carapezza was only 62. Today the hall of the university's Senate is named after him. The geology course that he established at Palermo's science faculty now hosts hundreds

of undergraduate students who study topics such as volcanoes, earthquakes, *tsunami* and similarly extreme natural events.

Alberto Monroy was heir to an ancient Sicilian family descending from the Spanish *conquistador* Cortez. He graduated in medicine in the mid-1930s from the University of Palermo under the supervision of Emerico Luna. At that time biology was part of medical studies and the study of biology did not include its "molecular" aspects and Monroy specialized in comparative anatomy. When Palermo was conquered by the American troops on July 1943, Monroy decided to leave for Naples on a military airplane and join the institute founded by the German zoologist Anton Dohrn. Monroy worked in embryology with Otto Mangold in Naples and became convinced that the developmental aspects of biology had their roots in chemistry. Along with Adriano Buzzati Traverso, Monroy understood that the obsolescence of research in biology practiced in Italy was due to the country's isolation during the Fascist regime (1922–1943). A revolution was taking place abroad with the discoveries of DNA and molecular biology and Italy was not a part of it. Besides losing eminent scientists to the United States, such as for example, Fermi and Segré, Italy's science remained isolated, particularly in the case of biomedical research. Thus Monroy decided to specialize abroad (Giudice 1987). In 1949 Monroy was among the first Italian biologists to move to the United States which was rapidly emerging as the world's leading country for research in biology. He worked with Alfred Mirsky at the Rockfeller Foundation in New York City, and then started work also at Woods Hole Marine Biological Lab (Massachusetts) where he met Erwin Chargaff and Paul Weiss.

In 1953 Monroy won the Chair of Comparative Anatomy at Palermo's science faculty where he soon founded the Institute of Comparative Anatomy naming it after "Andrea Giardina" – a Sicilian biologist who had discovered in 1901 a black small mass in the cells of the insect *Ditysticus marginalis* later identified as a pile of DNA containing the information needed for proteins synthesis: the ribosomes. In 1955, using microelectrodes capable of penetrating single cells, Monroy discovered that the fecondation of sea urchin eggs involves potassium ions transfer; then, in 1956 he proved that fecondation is associated with proteic synthesis and that when such synthesis occurs in the ribosomes, the latter organules associate in polyribosomes (1962).

In 1965 he published "Chemistry and Physiology of Fertilization"; in 1967 (and in 1985) along with C. Metz, Monroy co-authored "Fertilization" (Academic Press), while along with Aron Moscona he worked as editor of the "Current Topics in Developmental Biology" series for the same publisher from 1966 until his death (Moscona 1987).

Monroy held the chair of Comparative Anatomy at Palermo's University until 1969. As president of the science faculty from 1955, he was able to attract scientists such as the mathematician Lucio Lombardo Radice and biochemist Eduardo Scarano. He also rendered his institute a truly international institution by inviting to Palermo the Nobel prizewinners Salvador Luria, Chargaff, Dulbecco, Holländer and many others who later opened the doors of their laboratories to many young graduates from Monroy's

Table 3. Evaluation of Research at Palermo's University (2001–2003)

Discipline	Rank	E%	IF (mean)	Researchers
Biology	23/23	5	4.52	81
Earth sciences	7/15	47	2.17	22

Source: Civr, 2006. E% = % of excellent papers; IF = Impact Factor (Thomson 2006)

group. We may assume that in visiting Palermo many of these scientists were also motivated by Palermo's mix of violence, its rich historical heritage, its flourishing arts, and Sicily's splendid landscape: elements which were, and still are, powerful attractions for foreigners.

In 1969, however, Monroy decided to leave Palermo and move to Naples where the CNR had agreed to provide financial support to establish a new laboratory of embryology. He brought with him several young biologists and in 1976 was appointed director of the Zoological Station "Anton Dohrn," the same institute where he had worked 25 years before.

Like Carapezza, Monroy maintained an active role in public life. Hence, in Naples he decided to join Italy's Communist Party and was elected as a member of Naples' city council supporting the first communist mayor. In the 1930s Willi Münzenberg – a personal friend of Thomas Mann, Albert Einstein, Andre Gide, Romain Rolland, and many other great intellectuals – had shown how the communist cause could be advanced by attracting the best minds of western society (Koch 1994). Having been founded by the literature scholar Antonio Gramsci and later led for thirty years by his colleague Palmiro Togliatti, Italy's Communist Party was one of the best practitioners of Münzenberg's methods, and eventually benefited from proximity of the country's intellectuals, including Monroy and Carapezza. In 1980, Monroy's first student, Giovanni Giudice (who had been recently elected senator) completed another of Monroy's projects by founding the Institute of Developmental Biology in Palermo. Several young biologists soon joined the institute where they later achieved the first prenatal diagnosis of thalassemy and the first birth of a test-tube baby in Italy.

An honorary member of the American Academy of Arts and Sciences, Alberto Monroy died in Woods Hole on August 1986 at the age of 73. Twenty years after Monroy's and Carapezza's death, approximately 100 researchers are active in Sicily in the two institutions that are named after Monroy (the University's Department of Cellular and Developmental Biology and the CNR Institute); some 40 geochemists work at the former CNR Insititute of Fluids Geochemistry and at the university's Department of Earth Physics and Chemistry. Geochemical surveillance initiated by Carapezza in Italy has become mandatory for all Italy's active volcanoes. However, a simple analysis of the recent research output of the biology and geology schools founded in Palermo by Carapezza and Monroy shows that such schools were not able to maintain the level of their founders (see Table 3, Civr 2006). Research in biology

is the last among the 23 Italy's large university biology departments; whereas research in geology ranks seventh out of the 15 medium-size geology departments. Other geochemistry schools in Italy took Palermo's place. Pisa and Bologna are currently top-ranked. Their roots in older and traditionally top-ranked universities, far larger research budgets, and better instrumentation resources all contribute to these results.

Again, we should not entirely trust that the indices of excellent papers in fact capture the quality of a scientific school. Self-referential behavior at the organizational level is an unequivocal sign of managerial inadequacy which leads to isolation and decline. For example, accessing the website of Palermo's Department of Earth Chemistry <http://www.unipa.it/%7Ecfta> on March 2007 we are shown a poorly designed web page last updated three years ago (December 2004).

These results are not surprising. The second point of the present study, indeed, is that without a change of the system, no contribution of a "great man" can endure, and thus no scientific school will ever thrive in Italy if, after the founder's retirement, the legal system that intrinsically leads to cronyism will be allowed to exist.

> Perotti describes how this system actually works:
> University X wants to promote its own insider, and initiates a public selection. The commissioner from university Y supports tenure for the insider of university X, with the mutual understanding that university X will return the favor in the future when it comes to promoting university Y's insider. A second way to circumvent the control over inbreeding that the new system was designed to achieve (in a benevolent interpretation) is for university X to send its insider to university Y's selection, and promote him when he is given tenure there. The result well known in the profession is that all these public selection processes typically come with a label attached, that of the candidate (usually the internal candidate) who is intended to win. (Perotti 2002)

In order to be effective, therefore, change towards higher quality in the self interest of universities should enable a system to appoint and promote the most productive individuals, and enable resources to flow to the most successful institutions and their most capable members. Even in the absence of cronyism, however, it may not be assumed that schools founded by great leaders will continue to thrive. The historical record shows indeed the Niels Bohr Institute for instance lost its place among the top-ranked physics research centers after Bohr's death, despite considerable support from the government and private foundations.

It is notoriously difficult to make generalizations in sociology and other qualitative studies (Williams 2005). Yet, it is interesting to look at the common strategies that have guided the work of "great men" in shaping a discipline and a scientific school alongside the importance of their ability to adapt the system to their own needs even in a context where the structure (Italy's university system) is evolving along a route that is against such needs.

A third argument of this report concerns the cultural milieu in which Carapezza and Monroy were educated. Scientific talent is largely an innate gift and advanced education frees the potential of talented scientists enabling them to promote innovation in their fields. Advanced education, however, goes beyond updated discussion of contemporary scientific facts and theories. The teaching methodology that inspired the scientific educators of Carapezza and Monroy in the 1930s and in the 1940s was based on the philosophical approach of that time, namely that one should teach principles and scientific reasoning, not facts, and that since people are human, one should teach by describing real science and reasoning "in action" with all its uncertainties and false steps.

Getting back to our first argument, we believe that today's talented scientists should be educated in the conceptual foundations of their discipline and of science in general, in order to achieve a broader and better understanding of the interrelations between science and the rest of society. Thus, the creation of a truly advanced scientific school should demand of researchers that they be receptive to ideas from the most disparate domains, as only in this way can they understand the processes whereby knowledge grows.

Remarkably, this approach seems to have become mainstream; the website of the largest private, non-profit biomedical research organization in the world states that:

> The philosophy of The Scripps Research Institute emphasizes the education and training of researchers in biology and chemistry preparing to meet the scientific challenges of the next century; the creation of basic knowledge in the biological and chemical sciences for the application of medical and material discoveries; and the pursuit of fundamental scientific advances through *interdisciplinary* programs and collaborations. It is within the framework of this overarching mission that the students in the Graduate Program learn in an environment tailored to accommodate *individual* interests and capabilities.

Doing interdisciplinary and cross-disciplinary work poses great challenges and only recently have Italy's universities started to encourage boundary-crossing by simplifying departmental organization, appointing external professionals to teach, and initiating research in areas that are interdisciplinary in nature, such as the cognitive sciences and ecology. However, scientists in Italy are not rewarded for doing so as career advancements are still based on obsolete classes of subdisciplines such as for example organic chemistry, general chemistry, physical chemistry, and so on; which clearly penalizes scientists whose work extends outside their disciplines.

In summary, the importance of the historical case studies of Carapezza and Monroy lies in the formal approach chosen by these two Italian scientists in facing the cultural and practical challenges posed by their times. Scientific achievements are often related to first class individuals who may or may not generate equivalent high-standard scholars. Their lives pose a clear example of the opportunities as well as the threats facing those involved in reshaping Italy's academic system. Their work features a common

aspect, beyond scientific proficiency and international collaboration: the ability to reach out to people beyond their disciplines and to extend the boundaries of their intellectual work farther than the domains of their research. Excellent scientists should have good connections with the host society, but this is not necessarily their primary goal. A scientist is a researcher and then a manager of science and communication, different qualities that are rarely found together in a single person, as in the case of Carapezza. However, we wish to emphasize here that throughout this interaction with society, scientists can find new research avenues or rediscover research lines that were prematurely cut off.

Feyerabend (1975) offered a viewpoint on these topics that has become highly debated within the philosophy of science. According to Feyerabend science should be placed under democratic control of the citizens through free discussion and a vote. And even if his point has been strongly rejected by a majority of scientists, there is a consensus today that scientists working on themes with large societal consequences should actively engage with society in public debate (Appleyard 1992). Observing that this is exactly what Carapezza did throughout his career, we may appreciate his pioneering approach to the work of the scientists in a post-industrial society.

Young Italian academics who are working to making their laboratories internationally attractive may wish to take a similar approach in tackling the issues that force their best students to leave the country and find rewards elsewhere. It will not be easy, not least because the advantages enjoyed by Italy's university professors are large and (to them) most desirable. But it will bring great rewards.

In conclusion, I observe that most of those who participate in the debate on the crisis of Italy's universities are political economists (Marcello de Cecco, Francesco Giavazzi, Luigi Zingales, Roberto Perotti) who of course mirror the approach of their discipline, insisting on the importance of creating wealth and on evaluating research according to the quantity and the impact of their scientific publications. But what is really important to university education is its universal nature. And certainly, in this respect, it is not with university degree or "master" courses on topics such as "packaging" and "road safety" – lately introduced by the universities of Parma and Florence, respectively – that Italy's universities will raise the level of their overall quality or social relevance. In this sense, it is no surprise that the contribution of Italy's scientists to the debate is notable for its absence.

In brief, along with a constant decrease in quality as measured with indicators such as those suggested by economists, the understanding of both the origins and the aims of science has been generally lost as the philosophical spirit that permeated Italy's universities until the late 1960s vanished in concomitance with the rapid increase of students and professors to today's values (36,000 professors and 1.81 million students) (Crui 2006). We may therefore understand why a mere 2 per cent of Italy's population considers scientists to be socially relevant (Censis 2006). Reshaping work at Italy's universities requires rediscovering the approach of predecessors such as Alberto Monroy and Marcello Carapezza.

Acknowledgments

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