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Nuclear Italy

An International History of Italian Nuclear Policies during the Cold War

edited by
Elisabetta Bini
and Igor Londero

with the collaboration of
Giulia Iannuzzi

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Contents

Abbreviations

AA/USP	Arquivo Álvaro Alberto, Centro Interunidade de História da Ciência, Universidade de São Paulo, São Paulo, Brasil
AAm	Archivio Amaldi, Dipartimento di Fisica, Università "La Sapienza", Roma, Italia
AAn	Archivio Andreotti, Istituto Luigi Sturzo, Roma, Italia
AAPD	Akten zur Auswärtigen Politik der Bundesrepublik Deutschland, Das Institut für Zeitgeschichte, Berlin, Germany
ABC	Academia Brasileira de Ciência
ACDA	Arms Control and Disarmament Agency
ACS	Archivio Centrale dello Stato, Roma, Italia
AEC	Atomic Energy Commission
AECL	Atomic Energy of Canada Ltd.
AEP	Archivio Enrico Persico, Dipartimento di Fisica, Università "La Sapienza", Roma, Italia
AGIP	Azienda Generale Italiana Petroli
AHCEA	Archives historiques du Commissariat à l'Energie Atomique, Fontenay-aux-Roses, France
AHMRE	Arquivo Histórico do Ministério das Relações Exteriores, Brasília, Brasil
AM	Archivio Aldo Moro
AMN	Ansaldo Meccanico Nucleare
APA	Ambasciata di Parigi
APDA	Atomic Power Development Associates
APNB	Arquivo Paulo Nogueira Batista, Centro de Pesquisa e Documentação sobre a História Contemporânea do Brasil, Fundação Getulio Vargas, Rio de Janeiro, Brazil
ASE	ENI Historical Archive, Pomezia (Roma), Italia
ASMAE	Archivio Storico Diplomatico del Ministero degli Affari Esteri, Roma, Italia
ASPR	Archivio Storico Presidenza della Repubblica, Roma, Italia
AUSSME	Archivio dell'Ufficio Storico dello Stato Maggiore dell'Esercito
BNFL	British Nuclear Fuel Limited
BWR	boiling water reactor
CAMEN	Centro per le Applicazioni Militari dell'Energia Nucleare

CBPF	Centro Brasileiro de Pesquisas Físicas
CBTN	Companhia Brasileira de Tecnologia Nuclear
CCFP	Consultative Committee on the Fusion Programme
CdG	Comité de gestion/Comitato di gestione
CEA	Commissariat à l'énergie atomique et aux énergies alternatives
CEP	Calcolatrice Elettronica Pisana
CERN	Centre Européen pour la Recherche Nucléaire
CFPF	Central Foreign Policy Files
CIA	Central Intelligence Agency
CIP	Campo Internazionale per la Pace
CIPE	Comitato Interministeriale per la Programmazione Economica
CIRENE	CISE Reattore a Nebbia
CIRTEN	Consorzio Interuniversitario per la Ricerca Tecnologica Nucleare
CISE	Centro Informazioni Studi ed Esperienze
CIT	Compact Ignition Tokamak
CN	Combustibili nucleari
CNEN	Comissão Nacional de Energia Nuclear
CNEN	Comitato Nazionale per l'Energia Nucleare
CNPq	Conselho Nacional de Pesquisa
CNR	Consiglio Nazionale delle Ricerche
CNRN	Comitato Nazionale per le Ricerche Nucleari
Coren	Combustibili per reattori nucleari
CPF	Comitato Politico di Fisica
DC	Democrazia Cristiana
DDF	Documents Diplomatiques Françaises
DFR	Douneray Fast Reactor
DGAP	Direzione Generale Affari Politici
DP	Democrazia Proletaria
DSSMD	Diario Storico di Stato Maggiore della Difesa
EC	European Community
EDC	European Defence Community
EDF	Électricité de France
EEC	European Economic Community
ELDO	European Launcher Development Organisation
ENEA	Comitato nazionale per la ricerca e lo sviluppo dell'Energia Nucleare e delle Energie Alternative
ENEL	Ente Nazionale per l'Energia Elettrica
ENI	Ente Nazionale Idrocarburi

ENSI	Energia Nucleare Sud Italia
EPR	Evolutionary Power Reactor
ESRO	European Space Research Organisation
Euratom	European Atomic Energy Community
EURODIF	European Gaseous Diffusion Uranium Enrichment Consortium
FBR	fast breeder reactor
FGCI	Federazione Giovanile Comunista Italiana
FIG	France, Italy, Germany
FN	Fabbricazioni Nucleari
FOIA	Freedom of Information Act
FOM	Fundamental Research on Matter, Institute for Plasma Physics, Nieuwegein
FORATOM	European Atomic Forum
FT	Frascati Tokamak
FTU	Frascati Tokamak Upgrade
GIAU	Gruppo Italiano Arricchimento Uranio
GLCM	ground launched cruise missiles
HAEU	Historical Archives of the European Union, European University Institute, San Domenico di Fiesole (Firenze), Italia
HC	Archives du Haut-Commissaire à l'énergie atomique
HLG	High Level Group
HWR	heavy water reactor
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development
ICBSA	Istituto Centrale per i Beni Sonori ed Audiovisivi, Roma, Italia
IFOR	International Fellowship of Reconciliation
IGNITOR	Ignited Torus
IMAC	International Meeting Against Cruise
INF	intermediate-range nuclear forces
INFCE	International Nuclear Fuel Cycle Evaluation
INFN	Istituto Nazionale di Fisica Nucleare
IPQ	Instituto de Pesquisa Química
IRI	Istituto per la Ricostruzione Industriale
IRIS	International Reactor Innovative and Secure
ISODARCO	International School on Disarmament and Research on Conflicts
ITER	International Thermonuclear Experimental Reactor
JCL	Jimmy Carter Library, Atlanta, Georgia, United States
JET	Joint European Torus
JRC	Joint Research Centre

LASL	Los Alamos Scientific Lab
LEU	low enriched uranium
LGI	Laboratorio Gas Ionizzati
LMFBR	liquid metal fast breeder reactor
LRTNF	long-range theatre nuclear forces
LTBT	Limited Test Ban Treaty
LWR	light water reactor
MDA	Ministero della Difesa-Aeronautica
MIR	Movimento internazionale per la Riconciliazione
MIT	Massachusetts Institute of Technology
NAC	North Atlantic Council
NARA	National Archives and Records Administration, Washington, DC, United States
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NBC	Nuclear Biological Chemical
NET	Next European Torus
NPG	Nuclear Planning Group
NPPC	Nuclear Power Plant Company
NPT	Non-Proliferation Treaty
NRC	Nuclear Regulatory Commission
NSC	National Security Council
NUCLEI	Nuclebrás Enriquecimento Isotópico
OECD	Organisation for Economic Co-operation and Development
OECE	Organisation for European Economic Co-operation
PCI	Partito Comunista Italiano
PDUP	Partito di Unità Proletaria
PEC	Prova Elementi di Combustibile
PEN	Piano Energetico Nazionale
PFR	Prototype Fast Reactor
PIE	Post Irradiation Examination
PNE	Peaceful Nuclear Explosion
PR	Partito Radicale
PRO	Progetto Reattore Organico
PSDI	Partito Social-Democratico Italiano
PSI	Partito Socialista Italiano
PUN	Progetto Unificato Nazionale
PUREX	Plutonium and Uranium Recovery by Extraction

PWR	pressurized water reactor
RAI	Radiotelevisione Italiana
RAPTUS	Rapido-Torio-Uranio-Sodio
RRPL	Ronald Reagan Presidential Library, Simi Valley, California, United States
RWE	Rheinisch-Westfälisches Elektrizitätswerk AG
SALT	Strategic Arms Limitation Talks
SCG	Special Consultative Group
SELNI	Società Elettronucleare Italiana
SENN	Società Elettronucleare Nazionale
SICA	Sicurezza Internazionale e Controllo degli Armamenti
SIMEA	Società Italiana Meridionale per l'Energia Atomica
SME	Società meridionale di elettricità
SNAP	Systems for Nuclear Auxiliary Power
SNR	sodium-cooled fast reactor
TNA	The National Archives, Kew, Richmond, Surrey, United Kingdom
TNF	theatre nuclear forces
UKAEA	United Kingdom Atomic Energy Authority
UKNA	United Kingdom National Archives
UNAEC	United Nations Atomic Energy Commission
UNIPEDE	Union internationale des Producteurs et Distributeurs d'Énergie Électrique
USAEC	United States Atomic Energy Commission
USG	Ufficio del Segretario Generale
USIA	United States Information Agency
USPID	Unione Scienziati per il Disarmo
WEU	Western European Union

Elisabetta Bini and Igor Londero

Introduction

This book examines the history of Italy's nuclear policies during the Cold War, by placing the Italian case in an international and comparative framework. It highlights the importance the international context had in shaping the country's specific experience, and analyzes the ways in which international politics and economics, technological and scientific exchanges, as well as social and cultural movements, influenced Italian nuclear policies, both civilian and military. All the essays published in this volume assume that the history of nuclear energy should be written by adopting an international perspective. The spread of nuclear knowledge (scientific, civilian, as well as military), and the implementation of nuclear policies, have a specific international dimension that should be taken into consideration, since no nuclear program has ever had a distinctly national character, and every country pursuing a nuclear policy has been, in one way or another, deeply influenced by the international context.

Looking at the history of Italian nuclear programs through the lens of international and comparative history allows for a new understanding of the specificities – and in some ways uniqueness – of Italy's nuclear experience. The Italian case is defined by a series of distinctive traits that make its study particularly relevant. It was characterized by a strong tradition in applied nuclear physics, revolving around the so-called via Panisperna boys, who gathered around the charismatic figure of Enrico Fermi. While the group dispersed because of the racial laws introduced by the Fascist regime and, partly, because of the anti-Fascist activity of some of its members, the work carried out during the 1930s paved the way for post-World War II research in nuclear technology. It was immediately after the war that Italian scientists – including Edoardo Amaldi, the only member of the via Panisperna boys to have stayed in Italy – identified in applied scientific research a way to solve the country's secular social, political, economic and industrial problems, through the creation of a national committee for atomic energy.

During the 1950s, Italy was one of the first countries to express interest in developing civilian nuclear energy, taking advantage of the forms of assistance provided by the

United States through the Atoms for Peace program. In a context characterized by a lack of energy resources, politicians and industrialists alike embraced the idea that atomic power would offer the possibility of producing an unlimited, clean and efficient source of power. Through important figures such as Francesco Giordani – President of the Comitato Nazionale per l'Energia Nucleare (CNEN) – and Felice Ippolito – Secretary General of the Comitato Nazionale per le Ricerche Nucleari (CNRN, later renamed CNEN) –, Italy was at the vanguard of nuclear research and technology. The CNRN/CNEN directed all advanced research programs toward specific goals (like the building of the Frascati synchrotron and the first nuclear power plants), and advanced a specific vision of the role nuclear programs should have in promoting the country's modernization, through forms of state-led planning. It also served to develop an Italian scientific foreign policy, playing a leading role in establishing relations with the United States – the largest exporter of nuclear technology at the time – and participating in the building of a unified Europe through Euratom.

Despite the fact that in the mid-1960s Italy was one of the most advanced countries in terms of nuclear research, it was also one of the first nations to abandon nuclear power. Ippolito's indictment in the summer of 1963, and his subsequent imprisonment, were in many ways the result of a political decision about the modernization of Italy's economy, society and administration, which had deep consequences on the country's research policies and institutions, as well as on its long-term energy strategies. While much has been written about the so-called "Ippolito affair" and the decline of Italy's nuclear programs in the 1960s, we still know too little about how the Italian case differs from other European cases, and the ways in which Italian actors interacted with, and were influenced by, an international context characterized by debates about non-proliferation and by access to large quantities of cheap oil.

By placing the Italian case in a larger international and comparative framework, this volume draws on a growing literature about the history of nuclear policies during the twentieth century, which represents one of the most original fields of research in contemporary history. These studies use new methodological tools and incorporate a variety of approaches coming from different disciplines, such as the history of science, Science and Technology Studies, international relations, business history, literature and media studies, and the history of social movements, fields that often lie at the intersection of national, international and global history. With few important exceptions, the Italian case has remained on the margins of this scholarship, focusing on aspects of military power, or adopting a national perspective to the study of its subject matter. By using an interdisciplinary approach, this volume seeks to challenge existing barriers between the humanities and the hard sciences, thus contributing to the long-term debate about the "two cultures".

This book stems from a conference held in Trieste in November 2014, titled *Nuclear Italy. Storia internazionale del nucleare italiano* (Nuclear Italy. An International History of Italian Nuclear Policies), which drew together scholars from a range of different disciplines (history, physics, international relations, literature, and economics), all carrying out original research on the history of Italian nuclear policies. The conference was promoted and organized by Elettra Sincrotrone Trieste S.C.p.A. and the Humanities Department of the University of Trieste, alongside the Department of Political Sciences of the University of Roma Tre, and the Department of Documentary, Linguistic-Philological and Geographic Sciences of the University of Rome "La Sapienza". It was based on an international call for papers, and saw the presence of discussants selected from among the most important scholars in the field.

The 2014 conference built upon a previous one, organized by Elettra Sincrotrone Trieste S.C.p.A. and by the Graduate School of Humanities (SDiSU) of the University of Trieste in 2012, titled *Il nucleare in Italia nel secondo dopoguerra – ricerca, cultura, politica* (Nuclear Energy in Italy after World War II – Research, Culture, Politics). The conference examined Italy's nuclear experience by looking at the role played by Ippolito between the end of World War II and the mid-1960s. One of the results of the conference was the decision to create a research group working on the history of Italy's nuclear policies from a variety of different perspectives and through the lens of international history, which led to the establishment of the Nuclear Italy Research Group (Nireg).[1]

This volume is divided into four sections. The first section, "Civilian Uses of Nuclear Energy", examines Italy's use of nuclear energy for civilian purposes. The essays consider the country's relations with the United States and highlight the ways in which American policies such as the Marshall Plan, the Atoms for Peace program, and US military and corporate involvement in Western Europe, influenced Italian projects and strategies. They highlight the relationship between research institutions, the business world and the state in what was a very specific and peculiar case of post-World War II modernization, across the Atlantic and beyond. They analyze the role Italy had in shaping European nuclear policies, through forms of cooperation between Italian scientists and Euratom. These essays open up new venues of research on the importance scientific research had in promoting European integration, through men like Ippolito, who represents the prototype of a European technocrat involved in building a unified Europe. Despite the fact that many of Euratom's projects never saw the light, the agency gave life to a range of scientific programs that deserve to be studied, since they testify to the forms of international and European collaboration that characterized a whole era of nuclear research.

1 Nuclear Italy Research Group, https://niregblog.wordpress.com.

The second section, "Military Aspects of Nuclear Power", examines the importance the military dimension of nuclear policies had in shaping Italy's specific experience, particularly in the context of the signing of the Non-Proliferation Treaty (NPT) and the Euromissiles Crisis. By emphasizing the relationship between civilian and military uses of nuclear power, the essays in this section analyze the importance the nuclear arms race had in the creation of a "balance of terror", which kept international politics in checkmate for more than half a century. From the US policy of secrecy, to President Eisenhower's program Atoms for Peace, to the difficult compromises that led to the signing of the NPT, the question of nuclear arms dominated a whole era.

The third section, "Public Opinion and Anti-nuclear Movements", analyzes the different cultural and political meanings intellectuals, scientists and the media assigned to nuclear energy in Italy, at a time when nuclear power symbolized both the promise of unlimited growth and the threat of global annihilation. The essays examine the forms of communication that were carried out in support of or against nuclear energy, and how they intersected with wider changes in Italian society, symbolized by the spread of mass consumption, the emergence of a transnational public opinion, and new forms of grassroots democracy. They investigate the ways in which different groups critiqued and opposed the use of nuclear energy for military, civilian and research purposes. Compared to other countries, where anti-nuclear movements emerged during the 1950s and 1960s, in Italy they were initially a rather elitist initiative – albeit an influential one. It was only in the second half of the 1970s, and increasingly during the Euromissiles Crisis and the 1987 referendum, that they established themselves as a significant political force.

The fourth section, "The Role of Scientists and Scientific Research", examines the importance scientists and research institutes had in shaping Italy's nuclear experience. The essays focus on the relationship between scientists, the state, firms and society, and the specific contribution Italian researchers gave to the development of nuclear technologies. They show the complexity that characterized post-war research in nuclear physics, and the role scientists had in debates about the political, economic and ethical implications of nuclear power since World War II. These essays shed new light, and open up new questions, on the relationship between scientific research and ethical issues, which was so central in the thinking of scientists such as Albert Einstein and Robert Oppenheimer, but also Amaldi, reflecting on their responsibility in the context of the Manhattan Project. While the nuclear era led scientists to be increasingly influenced by large-scale industries and the state, it also brought about a new definition of the role they should have in society. Especially among those who were traumatized by the destructive power of the technology they had helped develop, scientists advanced the idea that they should be involved in public debates and assert their position. Investigating these aspects means highlighting the delicate relationship between intellectuals and researchers on the one hand, and society on the other, a topic which is particularly crucial today.

Acknowledgments

The organization of the conference *Nuclear Italy. Storia internazionale del nucleare italiano* and the publication of this volume would not have been possible without the contribution of many institutions and individuals. Our greatest thanks goes to Carlo Rizzuto, former President of Elettra Sincrotrone Trieste S.C.p.A., who from the very beginning supported this project with enthusiasm, and encouraged us to think outside disciplinary boundaries. Without his constant input, this volume – and the conference and networking behind it – would not have been possible. We also wish to express our gratitude to Elisabetta Vezzosi for her generosity, and for believing that the work we as academics carry out in groups is far better than what we produce as single individuals.

We would like to thank Elettra Sincrotrone Trieste S.C.p.A. for providing generous funding for the conference and the volume, as well as the Humanities Department of the University of Trieste, the Department of Political Sciences of the University of Roma Tre, and the Department of Documentary, Linguistic-Philological and Geographic Sciences of the University of Rome "La Sapienza", for their financial support. The administrative staff of Elettra Sincrotrone Trieste S.C.p.A. and of the Humanities Department of the University of Trieste gave us important assistance before, during and after the conference, and we would like to thank in particular Roberto Pugliese, Roberta Saccon, and Gloria Norio.

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Last, but certainly not least, we wish to express our deep gratitude to Giulia Iannuzzi for her invaluable contribution in organizing the conference and editing this volume in a superb way.

Part I - Civilian Uses of Nuclear Energy

Elisabetta Bini

Atoms for Peace (and War): US Forms of Influence on Italy's Civilian Nuclear Programs (1946-1964)*

This chapter analyzes the ways in which the United States influenced Italy's civilian nuclear policies between the end of World War II and the mid-1960s. Existing scholarship on the history of postwar US-Italian relations has largely overlooked this issue, with the important exception of studies about military uses of nuclear power.[1] Most research on the country's civilian nuclear energy programs has adopted a national perspective, and has focused on the differences and clashes between private firms and public agencies and research centers, or on the debates that accompanied the nationalization of the electric industry in the early 1960s.[2] Studies about Italy's energy policies, on the other hand, have mostly focused on oil and natural gas, and have examined the role the state-owned company Ente Nazionale Idrocarburi (ENI) had in reconstructing Italy after the Second World War and in challenging American interests in Italy and internationally.[3]

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* This chapter is part of a research project carried out at the University of Trieste between 2014 and 2016 with the support of Elettra Sincrotrone Trieste S.C.p.A. It presents initial results of a study of American documents held at the National Archives and Records Administration in College Park (NARA), namely the papers of the State Department, the American Embassy in Rome, the Central Intelligence Agency (CIA), the Joint Committee on Atomic Energy, and the Atomic Energy Commission (USAEC). I wish to express my gratitude to Professors Carlo Rizzuto and Elisabetta Vezzosi for their support and for their comments on previous versions of this paper.

1 Leopoldo Nuti, *La sfida nucleare. La politica estera italiana e le armi atomiche* (Bologna: il Mulino, 2007).

2 Mario Silvestri, *Il costo della menzogna. Italia nucleare, 1945-1968* (Torino: Einaudi, 1968); Giovanni Paoloni, ed., *Energia, ambiente, innovazione: dal CNRN all'ENEA* (Roma-Bari: Laterza, 1992); Valerio Castronovo, ed., *Storia dell'industria elettrica in Italia*, vol.4, *Dal dopoguerra alla nazionalizzazione, 1945-1962* (Roma-Bari: Laterza, 1994); Giovanni Zanetti, ed., *Storia dell'industria elettrica in Italia*, vol. 5, *Gli sviluppi dell'Enel (1963-1990)* (Roma-Bari: Laterza, 1994); Barbara Curli, *Il progetto nucleare italiano (1952-1964). Conversazioni con Felice Ippolito* (Soveria Mannelli: Rubbettino, 2000); Giovanni Paoloni, *Il nucleare in Italia* (Roma: Enel, 2008).

3 Angelo Pressenda and Marcella Sarale, *L'ENI da Mattei a Cefis: la politica del petrolio tra mito e realtà* (Torino: Einaudi, 1978); Giulio Sapelli and Francesca Carnevali, *Uno sviluppo tra politica e strategia: ENI (1953-1985)* (Milano: FrancoAngeli, 1992); Daniele Pozzi, *Dai gatti selvaggi al cane a sei zampe. Tecnologia, conoscenza e organizzazione nell'Agip e nell'Eni di Enrico Mattei* (Venezia: Marsilio, 2009); Elisabetta Bini,

Until the mid-1950s, when the United States developed the Atoms for Peace program, the US administration remained quite suspicious about Italy's project to develop a civilian nuclear energy program. Both the State Department and the Atomic Energy Commission (USAEC) kept firmly under control Italy's efforts to extract uranium in the North of the country. Their greatest concern was that the Italian government might declare its uranium property of the state, like it had done with its hydrocarbon resources. Despite a series of requests from Italian scientists and industrial firms, the Marshall Plan did not provide any funds for the purchase of nuclear equipment.

In the context of the Atoms for Peace program, the United States gained increased influence over Italy's atomic energy plans. While Italian firms and research centers expressed immediate interest in the program, the State Department and the USAEC used American aid and technology to shape Italian nuclear policies, in particular the relationship between public and private actors and agencies. They tried to strengthen the position of private Italian industrial groups such as Edison and Fiat, and contain the state-led forms of economic development promoted by the Centro Nazionale per le Ricerche Nucleari (CNRN) and its director Francesco Giordani. Furthermore, as part of the bilateral agreement between the two countries, they offered enriched, rather than natural uranium, thus making Italy dependent on a technology controlled by the United States.

While existing studies about US-Italian relations in the nuclear energy field have argued that the US undermined Italy's nuclear project, this chapter contends that Italian policies were only partly defined by the United States.[4] Rather, they were the outcome of a domestic conflict between public agencies and private firms, which used US interest in the country's nuclear program to promote their own specific interests. Along with the instability that characterized Italian governments at the time, these tensions delayed the signing of bilateral agreements, and negatively affected Italy's atomic program. When, in 1960, the Italian Parliament finally passed an atomic energy bill and established the Centro Nazionale per l'Energia Nucleare (CNEN) as Italy's main institution devoted to the development of peaceful uses of nuclear energy, American and Italian firms and agencies engaged in new forms of cooperation. Especially after John F. Kennedy became President, and in the context of the creation of center-left governments, the US administration and the USAEC supported the expansion of Italy's nuclear policies and a greater

La potente benzina italiana. Guerra fredda e consumi di massa tra Italia, Stati Uniti e Terzo mondo (Roma: Carocci, 2013). For a general overview: Pier Angelo Toninelli, "Energy and the Puzzle of Italy's Economic Growth," *Journal of Modern Italian Studies* 1 (2010): 107-127.

4 See in particular Simone Turchetti, "A Most Active Customer: How the US Administration Helped the Italian Atomic Energy Project to 'De-Develop'", *Historical Studies in the Natural Sciences* 5 (2014): 470-502.

role of the state in promoting civilian nuclear energy programs. In the first half of the 1960s, the US provided most of Italy's research reactors, and trained a new generation of Italian scientists in the US, while American firms participated in building two of the country's three nuclear power plants. In 1962 the American government viewed favorably the creation of the Ente Nazionale per l'Energia Elettrica (ENEL), a public agency that centralized the production of electric energy.

In this framework, the decline of the Italian nuclear program in the early 1960s was more the result of domestic conflicts than of American forms of influence. Once ENEL was founded, it decided to rely on oil, rather than nuclear power, to fuel its electric plants. This decision was the outcome of a complex set of decisions: on the one hand, following the decrease in the price of crude oil on the international market, Standard Oil (N.J.) flooded the Italian market with oil from North Africa. This strategy was supported by American oil companies operating in Italy, by the Italian refining industry and by ENEL, and by the State Department, which considered it a way of reducing Italy's reliance on Soviet oil. On the other hand, the shift away from nuclear power was closely linked to the decline of the forms of economic planning promoted by center-left governments in the early 1960s, and to a series of conflicts inside and between Italy's main political parties. When, in 1963, Secretary General of CNEN Felice Ippolito was accused of mismanaging public funds and removed from his position, public investments in the Italian nuclear program decreased rapidly. The government embraced a more "minimalist" policy, which made Italy increasingly dependent on imported fossil fuels. In the context of the "Ippolito affair", various sectors of the US administration and of the USAEC adopted a critical stance. They pointed out that the decline of Italy's civilian nuclear program represented a potential threat to the country's modernization, as it undermined one of its most advanced scientific, technological and industrial sectors.

The Early Postwar Years

Until the mid-1950s, the US administration was wary of any effort on the part of Italian firms and research centers to develop an atomic program. While the 1946 McMahon Act (or Atomic Energy Act) limited access to nuclear information to countries that had been US wartime allies, the 1947 peace treaty forbade Italy from acquiring or developing nuclear weapons. Through the regular despatches the US Embassy in Rome sent to the State Department, and through direct contacts between the Special Assistant to the Secretary of State for Atomic Energy and the USAEC, the American administration kept a close eye on Italian atomic energy programs. It also drew on personal contacts with Italian nuclear physicists working in the United States – such as Emilio Segrè and Federico Sensi – to receive reports on Italy's activities. In particular, it monitored the discovery of uranium mines in various parts of the country. Between the late 1940s and the early 1950s, it sent a representative of the Economic Cooperation Administration (ECA), along with several USAEC geologists, to carry out studies of uranium deposits in the area around the town of Cuneo, and asked private Italian firms to provide samples to be analyzed. Its aim was to control any sources that could be used by the United States for its own nuclear activities or in the framework of the Mutual Defense Assistance Program. The United States' greatest concern was that the Italian government might declare uranium a public property, as it had done with its hydrocarbon resources.[5]

Despite a series of requests from Italian scientists and industrial firms, the Marshall Plan did not provide any funds for the purchase of nuclear equipment. As a memorandum from the Office of the Under Secretary of State put it, "the Department considered it undesirable to establish as a precedent, purchase of nuclear research equipment with funds provided by the ECA".[6] The USAEC aimed at avoiding any association between ECA and atomic energy programs (also for public relations reasons). It decided not to include uranium among the strategic materials the United States might ask in exchange for American aid, so as not "to give to Communist propaganda such powerful corroboration of the claim that we were bargaining world economic health against perpetuation of an atomic monopoly for the United States".[7]

The US administration was not only worried about security, military and political issues, but aimed at influencing Italian (and, indeed, European) energy policies by assigning a crucial role to oil, as the main fuel of Europe's economic reconstruction. As David Painter has pointed out, "more than 10 per cent of the total aid extended under the Marshall Plan financed imports of dollar oil from US companies".[8] American aid created markets for US oil companies, and reconfigured Western Europe's energy pat-

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5 Richard G. Hewlett and Francis Duncan, *Atomic Shield: A History of the United States Atomic Energy Commission (AEC)*, Vol. II, *From 1947 to 1952* (University Park: Pennsylvania State University Press, 1969); Nuti, *La sfida nucleare*, 21-31. NARA, General Records of the Department of State (hereafter RG 59), Decimal File, 1950-1954, box 5314; NARA, RG 59, Office of the Secretary (hereafter OS), Special Assistant to the Secretary of State for Atomic Energy & Outer Space (hereafter S/AE), General Records Relating to Atomic Energy Matters (hereafter GRAE), 1948-1952, box 80; NARA, RG 59, OS, S/AE, GRAE, 1948-1952, box 51.

6 NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 76.

7 Under Secretary of the Department of State to Mr. Lovett, November 14, 1947, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 76. John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge: The MIT Press, 2006); John Krige and Kai-Henrik Barth, eds., "Global Power Knowledge: Science and Technology in International Affairs," special issue of *Osiris* 21 (2006).

8 David S. Painter, "The Marshall Plan and Oil", *Cold War History* 2 (2009): 160; Timothy Mitchell, "Carbon Democracy," *Economy and Society* 3 (2009): 399-432.

terns and relations, marking a sharp decline of British and German coal.[9] Italy received over 143 million dollars in petroleum aid, which placed Italy third in the ranking of Marshall Plan aid recipients of petroleum products.[10]

The US administration and the USAEC became increasingly involved in Italian nuclear policies after the CNRN was founded in 1952 under the direction of Francesco Giordani. A long-time supporter of state-led forms of intervention in the economy, and former President of the public company Istituto per la Ricostruzione Industriale (IRI) in the 1930s, Giordani believed that atomic energy should allow Italy to overcome its chronic dependence on the import of energy resources, and that the state should have a crucial role to play in developing a public agency specifically devoted to this task. In the first half of the 1950s, the USAEC's main concern was that the CNRN might introduce, as John A. Hall, head of the Commission's Office of International Affairs put it, a "governmental policy concerning uranium, its domestic use and control and export", and undermine American efforts to control global uranium resources.[11]

As the CNRN started drafting a new law regulating the production and use of uranium, Special Assistant to the Secretary of State for Atomic Energy Gordon Arneson wrote to the US Embassy in Rome and encouraged Ambassador Clare Boothe Luce to meet with Prime Minister Giuseppe Pella. In December 1953, Luce handed over to Pella a memorandum asking the Italian government assurances that "any uranium produced could be freely exported to the United States", in line with the 1950 mutual defense agreement, and pointed out that "Italy might retain such quantities of uranium as would be required in the Italian atomic energy program".[12] In exchange, the US would provide financial and technical assistance in locating and extracting uranium, and train Italian personnel. The Italian government showed little interest in the offer and postponed any decision on the matter. While the political context was highly unstable, the Italian government voiced, as Arneson put it, "the usual nationalistic reasons for resisting foreign development of mineral resources".[13]

The Atoms for Peace Program

9 David S. Painter, *Oil and the American Century: The Political Economy of US Foreign Oil Policy, 1941-1954* (Baltimore: The Johns Hopkins University Press, 1986); Stephen J. Randall, *United States Foreign Oil Policy Since World War I: For Profits and Security* (Montreal: McGill-Queen's University Press, 2005).

10 Painter, "The Marshall Plan and Oil", 166.

11 John A. Hall to Gordon Arneson, August 21, 1952, NARA, RG 59, OS, S/AE, GRAE, 1948-1952, box 80. On Francesco Giordani: Valerio Castronovo, ed., *Storia dell'IRI. Vol.1. Dalle origini al dopoguerra, 1933-1948* (Roma-Bari: Laterza, 2012); Barbara Curli, "Francesco Giordani e l'autonomia energetica", in ANIMI, ed., *Radici storiche ed esperienza dell'intervento straordinario nel Mezzogiorno* (Roma: Bibliopolis, 1996), 213-225.

12 Memorandum, December 23, 1953, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502.

13 Secret memorandum, October 13, 1954, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502.

It was in this context that US President Dwight D. Eisenhower announced the Atoms for Peace program, with the aim of promoting peaceful uses of atomic energy throughout the world. With the approval of the Atomic Energy Act in 1954, private firms were allowed to obtain information about nuclear energy production, and exchange information with foreign countries. As a result, in the mid-1950s the United States signed a series of bilateral agreements with most Western European countries, including Italy. The accord was the outcome of a long series of discussions between Italian and American government representatives, industrialists and scientists, and set the terms for American forms of influence on Italy's atomic energy policies.[14]

Given the strength of the Communist Party, Italy was not "just another country". It was especially Luce who expressed concern for American plans to help Italy develop an atomic program. During a meeting held in Paris in February 1955 (a few months before the signing of the bilateral agreement) between Deputy to the Special Assistant to the Secretary of State for Atomic Energy, State Department representatives and US Ambassadors in Europe, Luce pointed out that "with one-third of the Italian population voting Communist, there was no possibility for sufficient security arrangements to make possible a US-Italian bilateral agreement under present interpretation of the security provisions of the Atomic Energy Act of 1954".[15] The problem was also Italian public opinion, since Italian Communist broadcasts "commented that President Eisenhower failed to say whether the US would support an immediate ban on atomic weapons", while left-wing papers argued that the program was a reaction to the Soviet acquisition of the atomic bomb.[16] At the sime time, Luce recognized the positive effects the Atoms for Peace program might have, and argued that, "knowledge of the possibilities of a United States-aided atomic energy program could have a great effect in influencing the next Italian elections",[17] while the Central Intelligence Agency (CIA) was convinced that the program would "bring political and psychological benefits to the US".[18]

Italy expressed immediate interest in the American program, and was one of the first countries to do so. The forms of international cooperation promised by the Atoms for Peace program seemed to offer new possibilities to a country that was desperate to de-

14 Richard G. Hewlett, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley: University of California Press, 1989); Ira Chernus, *Eisenhower's Atoms for Peace* (College Station: Texas A&M University Press, 2002); John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," *Osiris* 1 (2006): 161-181.

15 NARA, RG 84, Records of the Foreign Service Posts of the Department of State, Italy, Rome Embassy, Records of Clare Boothe Luce (hereafter CBL), 1955-1957, box 4.

16 NSC Briefing, December 10, 1953, in NARA, CIA Records Search Tool (CREST).

17 NARA, RG 84, CBL, 1955-1957, box 4.

18 Memorandum for the Director of Central Intelligence, August 9, 1954, NARA, CREST.

velop autonomous forms of energy, but lacked the means and technology to do so. The CNRN pointed out that, "considering the scarce Italian availabilities of power and their prevailing high costs – the utilization of nuclear energy on an economical level would be reached in Italy sooner than in other Countries".[19] The CNRN wanted to receive 10 tons of heavy water, fissionable material, and a research reactor. Its aim was to obtain equipment and technology, while at the same time promoting an atomic energy policy that would be independent from the United States.[20]

Discussions about the bilateral agreement took place in Washington, DC, rather than in Rome. The US Embassy insisted that an American offer be made to Italian Ambassador Egidio Ortona rather than to the Italian government, "in order to prevent the possibility that Italians might tie up the approach … with our interest in uranium".[21] Ortona highlighted the interest the Italian government had in establishing forms of cooperation with the US, and argued that the CNRN wished to send a mission of atomic experts to the US in order to "pav[e] the way for the stipulation of a cooperation agreement".[22] He pushed the State Department to prepare a draft, so that Prime Minister Mario Scelba might sign it during his trip to the United States in March 1955. He also let the State Department know that Giordani and Edoardo Amaldi were "prepared to come to the US immediately to undertake the negotiation of a bilateral".[23] During his official visit to DC, Scelba was accompanied by Giordani who, along with Amaldi, Carlo Salvetti, Bruno Ferretti and Anna Baroni, represented the Italian government in the field of atomic energy.

Bilateral talks were immediately characterized by a growing American concern for the debate taking place in the Italian Parliament around the signing of an atomic energy bill. During Scelba's visit, Luce reported that the Italian government had approved a draft law assigning the state responsibility for the development of atomic energy in all its different phases. The bill – presented by Giordani and by Minister of Industry Bruno Villabruna, and submitted in February 1955 – promoted the idea that the state should have a direct role in prospecting for mines and using nuclear energy for industrial purposes, and that uranium should become a state property.[24] Luce heavily criticized the law,

19 NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

20 Paoloni, *Energia, ambiente, innovazione*.

21 Interim Programs to Develop the Peaceful Uses of Atomic Energy, January 6, 1955, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

22 Italian Embassy to Secretary of State, February 22, 1955, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

23 Memorandum of Conversation, February 14, 1955, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

24 Paoloni, *Energia, ambiente, innovazione*.

and Giordani's role in pushing the government to endorse it, and related the CNRN's proposal to the policies promoted by ENI and its President Enrico Mattei. Luce was particularly concerned about the Oil Law that was being discussed in Parliament, which hindered the activities of US private oil companies operating in Italy, by creating a monopoly over the exploration and extraction of hydrocarbons. The Ambassador went so far as arguing that "unconfirmed reports circulating to effect that law [on atomic energy] inspired by Enrico Mattei who plans absorb Natl Committee [CNRN] into framework of ENI".[25] She concluded that private companies might be better suited to carry out a program aimed at developing Italy's civilian atomic energy through bilateral relations with the United States, offering "concrete proof to long-claimed willingness Ital industry proceed with exploitation peaceful atom".[26] Luce's position was reinforced by General Electric representatives who, in a letter to the USAEC, argued that the Giordani-Villabruna bill would be "in contrast to that feature of the declared policy of the USA … that the development, use and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise".[27]

The USAEC used Giordani's visit to point out that it would not support the atomic energy bill, and that its approval might have deep consequences on the possibility for Italy of obtaining US assistance. As the US Embassy in Rome put it, "the reports of the Italian Atomic Energy Delegation to Washington re US criteria in Atomic Energy Cooperation, has now caused the Council of Ministers to instruct the Ministry to withdraw its first draft and present another with the objectionable monopoly features eliminated".[28] While discussions in the Italian Parliament stalled, the United States and Italy signed a bilateral agreement, according to which the United States would provide heavy water, while Italy could buy up to 600 kg of enriched uranium from the USAEC and a research reactor similar to the one installed at the Argonne laboratory. By focusing on enriched rather than natural uranium, the USAEC aimed at making sure that, as Simone Turchetti has argued, "countries receiving supplies … would be continuously reliant upon US imports to run their nuclear programs".[29]

25 US Embassy in Rome, March 18, 1955, NARA, RG 84, CBL, 1955-1957, box 9.

26 NARA, RG 84, CBL, 1955-1957, box 9.

27 NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502.

28 American Embassy Rome to Department of State, May 6, 1955, NARA, RG 84, CBL, 1955-1957, box 4819.

29 Turchetti, "A Most Active Customer", 480. See also John Krige, "The Peaceful Atom as Political Weapon: Euratom and American Foreign Policy in the Late 1950s", *Historical Studies in the Natural Sciences* 1 (2008), 5-44.

The agreement came into effect after the International Conference on the Peaceful Uses of Atomic Energy was held in Geneva in August 1955, during which Italian firms and agencies committed to developing an atomic program. Whereas Italian delegates proposed to build three nuclear plants and highlighted the presence of uranium resources in the northern parts of the country, the main private firms – Fiat, Montecatini, and Edison – expressed interest in purchasing reactors from the United States.[30] It was especially Edison, the biggest private Italian electric company, that took advantage of these debates to obtain material from the United States. In April 1955, Edison's CEO Giorgio Valerio sent a letter to the USAEC asking for its support in importing an American power reactor to Italy. He pointed out that, "Edison intends to increase further its steam generating capacity and it believes that the time has now come to turn to atomic energy using American equipment and engineering."[31] A few months later, he visited the United States, together with Mario Silvestri and the director of the company's thermal power stations, Franco Castelli, and started talks with Westinghouse to purchase a pressurized water reactor, which was supposed to be a duplicate of the one the American company was building for the Yankee Atomic Electric Company in Massachusetts. In December 1955, Edison founded the Società Elettronucleare Italiana (SELNI), with the aim of building a nuclear power plant in Trino Vercellese, near Turin.[32] The following year, Hall met with Vittorio Valletta, general manager of Fiat, to develop a joint program in the field of atomic energy and, in particular, build power reactors through the company Società Ricerche Impianti Nucleari (SORIN), with equipment provided by Westinghouse.[33]

In the second half of the 1950s, US-Italian relations in the field of atomic energy continued to be influenced by the debate about the atomic energy bill, which revolved around the relationship between public agencies and private firms. While Giordani received Segni's support for a bill reserving to the state the right to exploit materials needed to produce nuclear power, and giving it control over the industrial use of fissionable material, other Italian politicians advanced a different view of the country's atomic project. In 1956, Senators Giuseppe Caron and Stefano Perrier challenged the Giordani-Villabruna draft law by presenting another project, modeled on the 1954 US Atomic Energy Act, which would have allowed private industrial groups to develop atomic energy programs under government control.

30 American Embassy in Rome, August 12, 1955, NARA, RG 84, CBL, 1955-1957, box 9.

31 Giorgio Valerio to USAEC, April 14, 1955, NARA, RG 326, Records of the Atomic Energy Commission, Office of the Secretary, General Correspondence, 1951-1958, box 111.

32 Valerio Castronovo, *Il gioco delle parti. La nazionalizzazione dell'energia elettrica in Italia* (Milano: Rizzoli, 2012).

33 Atomic Energy Developments in Italy, February 7, 1957, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

The debate stalled in Parliament and slowed down relations with the USAEC. Giordani traveled to the United States in January 1956 to close the deal and buy a research reactor to be placed at Ispra, near Milan. While in the United States, he met with Hall and asked for a revision of the bilateral agreement, in order to purchase a larger quantity of enriched uranium, as well as a power reactor. Just before Giordani left for the United States, Luce "suggested that if the Italians approach us for a power bilateral agreement, we should insist that they establish their own basic atomic energy law first".[34] Gerard Smith of the USAEC replied unofficially that the US government "would probably like to see the Italian atomic energy legislation prior to the completion of an agreement for cooperation in the power reactor field".[35]

The Italian Council of Ministers approved the bill in the Fall of 1956, shortly after Giordani resigned from his position and was replaced by Felice Ippolito, another strong supporter of a state-led nuclear program. In his remarks before the Council, Minister of Industry and Commerce Guido Cortese argued that, "The bill has taken into account the experience behind foreign legislation and that provided by the various international conferences. … Our law … is specifically designed to give to private enterprise sufficient guarantees and incentives to enable it to intervene with adequate investments in the mining phase as well as that of industrial utilization".[36] However, the proposal stalled in Parliament and was eventually withdrawn in 1958, at the end of the legislature. In the meantime, the CNRN proposed an interim law regulating the role the agency should have, and presented a new bill, creating the CNEN under the control of the Ministry of Industry and Commerce. It took another three years for the bill to be approved and come into effect.

While the US administration pushed the Italian government to pass a law that would be acceptable to the United States, it was the contrast between public agencies and private firms, and the lack of stable governments, that delayed the signing of bilateral agreements and negatively affected Italy's atomic program. When, in 1957, the Italian government asked the State Department to revise the bilateral agreement in order to import more fuel to operate the country's three reactors, the US Embassy pointed out that, "neither of two government groups now in the field, Agip Nucleare and Società Energica Nucleare (SEN) [*sic*], have been able to come up with concrete projects".[37] In

34 Memorandum for the file, January 10, 1956, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502.

35 Italian Atomic Energy Development, January 17, 1956, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 503.

36 American Embassy Rome to Department of State, October 1, 1956, NARA, RG 84, CBL, 1955-1957, box 4819.

37 David Zellerbach to Secretary of State, May 17, 1957, NARA, RG 59, Central Decimal File (hereafter CDF), 1955-1959, box 2541.

such a context, "it is very difficult indeed to plan a coherent atomic energy program with no law or regulation on which to base it, and with authority and responsibility for the program dispersed and unclear".[38] According to the new agreement signed in 1957, Italy would receive 7,000 kg of enriched uranium over a twenty-year period, while the United States would supply enriched uranium for two power plants.

The contrast between public agencies and private firms led to a delay in Edison's plan to build a nuclear power plant in northern Italy using American technology. As Valerio put it, one of the main problems was that there was no "'agreement of cooperation' between the United States and Italian government, appropriate authorizations from the governmental agencies concerned, provision for supply of nuclear fuel". The main issue, though, was that Edison encountered countless problems in obtaining funding from the Export-Import Bank, despite the fact that the USAEC pressured banks to provide loans to private foreign companies.[39] It was especially the Italian government that undermined Edison's activities. In the winter of 1956-1957, Cortese – under pressure from Ippolito – turned down the company's request to receive a bill of exchange guarantee for the Export-Import Bank loan.[40] The controversy continued, and in 1959 the Minister of Industry had not yet approved the site of the SELNI reactor. A report sent to the State Department pointed out that,

> The Embassy understands that the Secretary General, Ippolito, of the CNRN has taken an interest in the matter. Ippolito is an outspoken opponent of private participation in nuclear power development, as in the SELNI project, and is a particular foe of the parent Milan Edison group. Ippolito's influence could quite possibly be brought to bear … to delay approval of the site chosen by SELNI. This could prevent private industry from becoming established in the nuclear power field, and this getting a foot in the door, before this question comes under examination in the legislative consideration of the proposed basic nuclear law.[41]

The Italian Ministry of Industry dragged its feet for years, refusing to issue an official permit to allow construction of the plant. The American Embassy explained the situation, stating that, "the Ministry has hesitated to authorize construction of the SELNI plant because the long standing controversy on whether private interests will be permit-

38 Report on Atomic Energy Developments in Italy, December 19, 1957, NARA, RG 84, CBL, 1955-1957, box 4819.

39 Edisonvolta purchases a large power reactor, December 20, 1956, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502; Felice Ippolito and Folco Simen, *La questione energetica (dieci anni perduti 1963/1973)* (Milano: Feltrinelli, 1974).

40 Ippolito and Simen, *La questione energetica*, 28.

41 AmEmbassy to Department of State, April 6, 1960, NARA, RG 59, CDF, 1960-1963, box 2690.

ted to operate Italian nuclear power plants has not yet been resolved by Parliament."[42] The Embassy intervened through its Economic Counselor, who pressured the Italian government to take a clearer stance. It "assured Minister Colombo that the issue of public vs. private nuclear power was recognized as an internal Italian matter", but it also pointed out that "the Westinghouse company has already committed a considerable amount of money in work … and therefore is anxious to have the project authorized to go ahead regularly".[43]

In 1960, the Italian Parliament finally passed the atomic energy bill it had been debating since the mid-1950s. The law established the CNEN as Italy's main agency devoted to the development of peaceful uses of atomic energy. Placed under the control of the Ministry of Industry, CNEN promised to allow Italy to overcome its chronic lack of energy resources. In the early 1960s, it was one of the most advanced agencies in Western Europe, and set Italy among the most advanced countries – along with Japan – in the field of civilian nuclear energy.[44]

The American Embassy in Rome kept closely under control Italian discussions about the so-called Colombo Bill, which eventually led to the creation of CNEN, fearing that it might exclude private firms from operating in the field of nuclear energy. Once the bill was passed, the Embassy recognized that, "a major obstacle in the way of planning and carrying out a long range Italian national nuclear program was removed",[45] and that Italy could gain "a position of European, if not world, prestige and leadership in the nuclear field".[46] CNEN would encourage new forms of planning which, in the Embassy's view, "in the past ha[ve] been hampered by the fact that allocations were made on a year to year basis".[47] Thanks to this new institutional context, a series of agreements signed by American and Italian firms and agencies in the second half of the 1950s finally came into effect. These included building a nuclear power plant in the Southern town of Garigliano, which was based on an agreement between the state-owned Società Elettronucleare Nazionale (SENN) and General Electric and received funding from the World Bank; and operating Italy's first research reactor in Ispra, which was sold by the American Car and Foundry Company and was partly funded by the USAEC.[48] By 1961, the United States provided Italy with six research and training reactors, along with the

42 AmEmbassy to Secretary of State, January 29, 1961, NARA, RG 59, CDF, 1960-1963, box 2691.

43 AmEmbassy to Secretary of State, March 8, 1961, NARA, RG 59, CDF, 1960-1963, box 2691.

44 Ruggero De Leone and Cecilia Dau Novelli, "Dal Cnen all'Enea, 1960-1982," in Paoloni, *Energia, ambiente, innovazione*, 71-160; Silvio Labbate, *Il governo dell'energia. L'Italia dal petrolio al nucleare (1945-1975)* (Firenze: Le Monnier, 2010).

45 AmEmbassy to Department of State, May 6, 1961, NARA, RG 59, CDF, 1960-1963, box 2691.

46 AmEmbassy to Department of State, May 6, 1961, NARA, RG 59, CDF, 1960-1963, box 2691.

47 AmEmbassy to Department of State, October 18, 1960, NARA, RG 59, CDF, 1960-1963, box 2690.

48 Piero Isola, *Odissea Garigliano. Storie del nucleare in Italia* (Manziana: Vecchiarelli, 2004).

enriched uranium needed to fuel them. Among them, the Progetto Reattore Organico (PRO), which was the outcome of a close collaboration between AGIP Nucleare, Fiat, and Montecatini on the Italian side, and the Martin Marietta Corporation from Baltimore and Atomic International on the American side.[49]

The only exception remained the building of the SELNI nuclear power plant, which became the object of a heated political controversy in the context of the debate about the nationalization of Italy's electric industry. In 1962, SELNI and Westinghouse pushed the US administration to approve the shipment of the reactor needed to operate the plant. The State Department replied by asking CNEN for an official statement that the reactor was part of the US-Italian bilateral agreement. However, the Italian government refused to issue the statement considering how politically sensitive the matter was. A CNEN representative in Washington, DC, "advised that due to governmental crisis and likelihood of nationalization nuclear industry in 'opening to left' of new coalition no official Rome presently in position state SELNI authorized receive shipment."[50] The State Department concluded that "any implication of US interference in planned nationalization, nuclear power or SELNI reactor specifically must of course be avoided."[51]

The Nationalization of the Electric Industry

In November 1962, the Italian Parliament voted to create ENEL, which centralized the production of electric power. The law was part of a wider debate, carried out by the Italian Parliament between the second half of the 1950s and the early 1960s, about the need to create center-left governments, based on a coalition between the Christian Democratic Party (DC), the Italian Socialist Party (PSI) and the Italian Social-Democratic Party (PSDI). The establishment of ENEL was one of the conditions set by the PSI for supporting the creation of a center-left government.[52]

In the late 1950s, the US administration remained weary about socialists' participation in the Italian government. Its attitude changed after John Foster Dulles – a fierce anti-Communist – left his position as Secretary of State in 1958. However, the United

49 US Participation in Inauguration of Italy's First Nuclear Reactor, April 22, 1959, NARA, RG 84, CBL, 1955-1957, box 4819; Felice Ippolito to Wells, Director of International Affairs, USAEC, March 1960, NARA, RG 59, OS, S/AE, GRAE, 1948-1962, box 502. See also Paoloni, *Il nucleare in Italia*.

50 Department of State to AmEmbassy, February 23, 1962, NARA, RG 59, CDF, 1960-1963, box 2695.

51 Department of State to AmEmbassy, February 23, 1962, NARA, RG 59, CDF, 1960-1963, box 2695.

52 Labbate, *Il governo dell'energia*; Leopoldo Nuti, *Gli Stati Uniti e l'apertura a sinistra. Importanza e limiti della presenza americana in Italia* (Roma-Bari: Laterza, 1999); Valerio Castronovo and Giovanni Paoloni, eds., *I cinquant'anni di ENEL* (Roma-Bari: Laterza, 2013).

States still wanted to make sure that the new government would confirm Italy's membership in the Atlantic Alliance and avoid any form of neutralism. Prime Minister Amintore Fanfani's trip to the United States in June 1961 was, in this sense, crucial. Just before he left for Washington, DC, Charles Douglas Jackson, who had been Eisenhower's special assistant, sent a report to President John F. Kennedy, pointing out that the PSI was indeed breaking away from the Communists.[53]

While the nationalization of the Italian electric industry reminded many of the forms of economic nationalism carried out by ENI in the oil field, the US administration and the American Embassy recognized the political and economic importance of ENEL. As the Embassy put it, "the nationalization of electric power can be viewed as a defensible political compromise adopted in the hope of furthering long-range political objectives of major importance to the country. In this light, the purpose was to obtain support for a center-left government from socialists … who are loyal to democratic principles and therefore fundamentally opposed to communism, while being nothing worse than doctrinaire".[54] According to the US administration, the creation of ENEL was not so radical, since center-left governments did not intend to nationalize other sectors, private firms could continue to operate, and ENEL might have overall positive effects on the Italian economy, boosting the government's economic planning policies, particularly in the South. The United States' main concern was the proposal – advanced by ENI – to nationalize all energy sectors. Once ENEL was established, the US Embassy reported optimistically that, "the limitation of the proposed new agency to electric power production would seem to end the hopes of those who from time to time have proposed creation of a gigantic single state agency to control the whole energy sector", while at the same time limiting the possibility on the part of the CNEN of establishing full control over the Italian nuclear sector.[55]

ENEL, however, decided to rely on oil, rather than nuclear power, to fuel most of its electric plants. The decision was tied to economic and political reasons, and depended on a series of changes that characterized the national and international energy market. The most important one had to do with the declining price of crude oil, linked to the discovery of new fields in North Africa. Furthermore, in the early 1960s the United States' approach to Italian oil policies changed significantly. After ENI signed a series of treaties with the Soviet Union for the import of crude oil, the US administration and American oil companies intervened to stop Mattei's activities. In 1963, with the support of the State Department, ENI and Standard Oil (N.J.) signed an agreement,

53 Catronovo, *Il gioco delle parti*, 163.

54 AmEmbassy Rome to Department of State, October 1, 1963, in NARA, RG 84, Italy, US Embassy Rome, Classified General Records (hereafter CGR), 1946-1964, box 28.

55 AmEmbassy to Department of State, July 20, 1962, NARA, RG 59, CDF, 1960-1963, box 2695.

according to which the American oil company would provide ENI with crude oil and natural gas it extracted in Libya, in exchange for technical equipment. The treaty reduced Italy's dependence on Soviet oil and allowed Esso to find an outlet for its hydrocarbon resources.[56]

Thanks to these deals, Italy received large quantities of cheap oil, which it refined in its many plants, especially the ones located in Sicily. Part of the refined products was sent to other Western European countries, but what was left was used to fuel Italy's electric industry. The government's and ENEL's strategy was largely supported by American oil companies operating in Italy, as well as by ENI and the Italian refining industry.[57] ENEL's decision to rely on oil to fuel its electric plants led to a sharp decline of Italy's nuclear program, given that the agency reduced its investments in the nuclear sector and relied almost entirely on cheap oil rather than on a more diversified range of energy sources. As a result, despite the country's advances in the nuclear sector, by the second half of the 1960s only 5% of Italy's electricity came from nuclear power. This decision had long-term effects, since it made the Italian economy and industry largely dependent on imported oil and increasingly vulnerable to the changes of the international oil market, as was clear during the 1973 oil "shock".[58]

The "Ippolito Affair"

Italy's shift away from nuclear energy was also the result of political decisions. In the summer of 1963, Giuseppe Saragat, leader of the PSDI accused Ippolito of mismanaging public funds. After a long trial, Ippolito was removed from his position, leading to a decline of public investments in nuclear programs. The American Embassy in Rome reported widely on what it called the "Ippolito scandal" and the subsequent trial. When Saragat made his accusations, it highlighted how "Saragat's stand on question of nuclear power has distinct political connotation. Evidently prepared for him by experts in the field who oppose nuclear plants, his statements seem aimed at discrediting Felice Ippolito".[59] A week later, the Embassy confirmed its opinion that "Saragat's principal

56 Archivio Storico ENI (ASE), Fondo ENI, Presidenza, Raffaele Girotti, b. 76, f. 3369. On US reactions to the treaty between the Soviet Union and ENI: Elisabetta Bini, "A Challenge to Cold War Oil Politics? The US and Italy's Relations with the Soviet Union, 1958-1969", in Jeronim Perovic, ed., *Cold War Energy: A Transnational History of Soviet Oil and Gas* (London: Palgrave Macmillan, 2017): 201-230.

57 De Leone and Dau Novelli, "Dal Cnen all'Enea", 91-92.

58 AmEmbassy Rome to Department of State, February 1, 1963, NARA, RG 84, Italy, US Embassy Rome, CGR, 1946-1964, box 28. Elisabetta Bini, "A Transatlantic Shock: Italy's Energy Policies between the Mediterranean and the EEC, 1967-1974," *Historical Social Research*, 4 (2014): 145-164.

59 AmEmbassy in Rome to Ruepda, August 1963, NARA, RG 59, Central Foreign Policy File (here-

motives were political rather than economic, although he … has been concerned with large expenditures involved in building and operating nuclear power stations".[60] It immediately linked the accusations to the policies carried out by the center-left governments, and argued that,

> [Saragat] has raised question of type of center-left to be created … namely, whether it would be a center-left that would institute needed social and economic reforms with full respect for individual initiative and enterprise, or center-left of type sought by such left-wingers as Riccardo Lombardi and Ugo La Malfa, who advocate basic structural changes in economy.[61]

Saragat's support for the first option obviously meant undermining the reformist ethos that had characterized political discussions concerning the founding of ENEL and CNEN's programs.

US representatives immediately considered the political repercussions of the "Ippolito affair". While the CIA reported that "revelations of conflicts of interest in the government Nuclear Energy Committee are causing a political uproar that may complicate maneuvers this fall to form a new government",[62] the American Embassy pointed out that the Italian Communist Party (PCI) might take advantage of the situation, by taking sides with Ippolito and trying to broaden the investigations to various DC Ministers of Industry.[63] Furthermore, it argued that, "the government has handled the case very gingerly apparently because many important personalities had been subsidized by Ippolito [Lombardi and La Malfa in particular]".[64]

The Embassy initially pointed out that the "Ippolito 'scandal' is but one of several involving top government officials which have blown up Italy in past few years … [Ippolito] appears to [*sic*] deeply implicated to escape completely unscratched."[65] The Ambassador argued that, "The decision to arrest Ippolito would also seem to indicate the Government's determination to do something positive about the rash of economic and political scandals that have beset Italy in the past several years, and possibly enhance its public image at a time when popular support for its programs is so eagerly sought".[66]

after CFPF), 1963, POL, box 3951.

60 AmEmbassy in Rome to Ruepda, August 1963, NARA, RG 59, CFPF, 1963, POL, box 3951.

61 AmEmbassy in Rome to Ruepda, August 1963, NARA, RG 59, CFPF, 1963, POL, box 3951.

62 CIA, September 19, 1963, NARA, CREST.

63 AmEmbassy in Rome to Ruepda, September 1963, NARA, RG 59, CFPF, 1963, POL, box 3951.

64 AmEmbassy in Rome to Department of State, October 17, 1963, in NARA, CFPF, POL, box 3952.

65 AmEmbassy in Rome to Ruepda, August 1963, NARA, RG 59, CFPF, 1963, POL, box 3951.

66 AmEmbassy in Rome to Department of State, March 5, 1964, in NARA, CFPF, 1964-1966, Political & Defense, box 2366.

However, during the trial the Embassy changed its initial impression that "firm evidence has been uncovered against Ippolito", and pointed out that Ippolito "administered the agency, and its funds, in accordance with CNEN directives", and that, despite his "deplorable personal traits … his staff felt that he was accomplishing the desired objective of moving Italy ahead in the field of nuclear technology".[67] One year after the outbreak of the "Ippolito affair", the Embassy pointed out that one of the main results had been to waste "a year in the field of nuclear research and development", reduce "the country's stature and prestige in international nuclear agencies", and convince the public that nuclear power was too expensive for Italy.[68]

Conclusion

Between the end of World War II and the mid-1960s, Italy's civilian nuclear program was profoundly influenced by the Cold War and, in particular, by US policies and interests in Western Europe. Until the mid-1950s, the US administration and the US-AEC kept Italy's uranium resources under control, and did not provide any aid or funds for the purchase of nuclear equipment under the Marshall Plan. Once the Eisenhower administration introduced the Atoms for Peace program, the US used its bilateral agreements with Italy to shape the country's civilian nuclear program, by strengthening the role of private industrial groups and providing enriched, rather than natural uranium, thus making Italy dependent on a technology controlled by the US.

This chapter has argued that, rather than simply representing an imposition of American technology and industrial strategies, US policies interacted in complex ways with a variety of Italian actors, which offered their own interpretations of the meaning of civilian nuclear projects for the country's modernization. Until the early 1960s, when the Italian Parliament finally approved an atomic energy bill and created the CNEN, the US encountered many forms of resistance on the part of Italian politicians and institutions. These were tied to a specifically domestic struggle between public and private firms and research centers, revolving around the nationalization of the electric industry, which hampered the development of Italy's nuclear program. Once CNEN was established and the Italian government started supporting the idea that the development of a nuclear policy should be part and parcel of the forms of economic planning and modernization

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67 AmEmbassy in Rome to Department of State, August 7, 1964, NARA, CFPF, 1964-1966, Political & Defense, box 2366.

68 AmEmbassy in Rome to Department of State, August 19, 1964, NARA, CFPF, 1964-1966, Political & Defense, box 2366.

promoted by the center-left coalitions, the US became actively involved in providing Italy with reactors, and training a new generation of Italian scientists and technocrats.

The link between the development of a civilian nuclear program and Italy's modernization came to a sudden halt in the early 1960s, after the creation of ENEL and in the aftermath of the "Ippolito affair". This chapter has shown that the decline of public investments in the nuclear sector was only partly the result of American forms of pressure. While US oil companies and the State Department pressured the Italian government and ENI to buy large quantities of cheap crude extracted in North Africa, thus reducing the country's dependence on Soviet petroleum, ENEL's resolution to rely on oil, rather than nuclear power, to fuel its electric plants, was a domestic choice. It resulted, once again, from a struggle between public and private firms and interests, and intersected with the decision, on the part of the Italian government, to marginalize the forms of economic planning and modernization that had characterized the late 1950s and early 1960s. In this framework, it should come as no surprise that the American Embassy, the US administration and the USAEC interpreted the "Ippolito affair" as putting an end to one of Italy's most advanced scientific, technological and industrial projects, and undermining Italy's international prestige.

Fabio Lavista

Political Uncertainty and Technological Development: The Controversial Case of AGIP Nucleare (1956-1962)

Investing in high-technology, capital-intensive sectors is risky, because revenues are delayed over time and because it is often very difficult to forecast the pattern of development of technological regimes,[1] especially if they are in their formative period, as was the nuclear energy sector during the 1950s. Moreover, investments' potential positive performance is strictly linked with the ability to acquire technical, as well as managerial and organizational, capabilities. Every effort to innovate in these sectors is, in fact, the result of a process of trial and error, a learning process in which gaining access to the knowledge structured or embodied in machinery is relevant, as is the ability to coordinate complex socio-technical systems.[2] As several scholars have argued, a successful innovation is often not a matter of invention, but mainly a matter of design, in the sense of devising efficient products or processes, given some cost constraints.[3] This is true for pure innovation, but also for the transfer of technology: in both cases, designing new technology is a risky activity, since technical uncertainty can rapidly translate into huge financial losses.

Regardless of the path followed to acquire knowledge and design efficient innovation processes, the implementation of a new technological regime is a costly and time-consuming activity, especially in cases in which the entire national innovation system is involved. In these cases, among which we can list the production of nuclear energy, the institutional framework is particularly relevant. Several scholars have highlighted the importance public policies have in fostering technological investments. These can ensure the presence of a stable institutional framework, which in turn allows for large

1 Franco Malerba and Luigi Orsenigo, "Technological Regimes and Sectoral Patterns of Innovative Activities", *Industrial and Corporate Change* 6, no. 1 (1997): 83-118.

2 Franco Malerba and Richard R. Nelson, eds., *Economic Development as a Learning Process: Variation across Sectoral Systems* (Cheltenham, UK-Northampton, MA: Edward Elgar, 2012), 1-20.

3 Richard R. Nelson, ed., *National Innovation Systems: A Comparative Analysis* (New York: Oxford University Press, 1993), 8-9.

investments, guaranteeing the amount of time needed to put into effect processes of knowledge acquisition and transfer. Reducing political uncertainty is very important, given that the lack of clear orientations deeply affects investments.[4] Since technological projects are not fully reversible, in the face of uncertainty protagonists become extremely cautious, and hold back on investments to such a degree that it seems possible to directly link political instability to the succession of cyclical investment fluctuations.[5]

Political certainty is always important for technological development, but different industrial sectors respond differently, in relation to the degree of complexity that characterizes them. The more an industrial sector's technology is complex, the more political stability is needed for its development. For instance, political certainty helps to explain the development of the electro-nuclear sector, because of the technology involved and the amount of investments needed to start a nuclear energy production plant. In this case, two other aspects have to be taken into consideration, which were particularly evident during the 1950s: the nuclear sector's dependence on international relations, and the relevance of state intervention. After World War II, for the majority of industrialized countries, the possibility of succeeding in the production of nuclear energy was radically linked to the import of technology and nuclear fuel from the United States and the United Kingdom.[6] Foreign policy was therefore crucial in determining the success or failure of technological innovation strategies. National industrial policies were equally important, given the degree of state intervention in the sector, both indirect – by means of regulation –, and direct – through state-owned enterprises.

This chapter examines the relationship between political uncertainty and technological development, through a study of the Italian electro-nuclear industry during the 1950s. It focuses in particular on the case of the Azienda Generale Italiana Petroli (AGIP) Nucleare, an electro-nuclear firm affiliated to the Ente Nazionale Idrocarburi (ENI), the main Italian oil public holding. The first paragraph discusses the role of state-owned enterprises and politics, and is followed by a brief analysis of the Italian government's electro-nuclear policy. The third and fourth paragraphs examine ENI's behavior in the energy sector, and give an account of the political difficulties the company faced both nationally and internationally. Finally, the chapter draws some conclu-

4 Alfred A. Marcus, "Policy Uncertainty and Technological Innovation", *The Academy of Management Review* 6, no. 3 (1981): 443-48.

5 Ben S. Bernanke, "Irreversibility, Uncertainty, and Cyclical Investment", *The Quarterly Journal of Economics* 98, no. 1 (1983): 85-106; Nick Bloom, Stephen Bond, and John Van Reenen, "Uncertainty and Investment Dynamics", *The Review of Economic Studies* 74, no. 2 (2007): 391-415.

6 Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley: University of California Press, 1989); John Simpson, *The Independent Nuclear State: The United States, Britain, and the Military Atom* (New York: St. Martin's Press, 1983).

sions on the role political choice had in determining the success or failure of technological development processes.

State-Owned Enterprises and Technological Development

During the 1950s, countries that decided to enter the nuclear sector created public agencies devoted to research and development, and started funding national nuclear programs. In some cases, the state was directly involved in building nuclear plants; in other cases, private companies had greater freedom.[7] In Italy, the role of the state was particularly relevant: in 1952, the government founded the Comitato Nazionale per le Ricerche Nucleari (CNRN), a national agency aimed at carrying out research in the field of nuclear energy, while state-owned enterprises were involved in the construction of two of the three nuclear plants that were built in the 1950s.[8]

In this respect, it has to be considered that by definition state-owned enterprises do not pursue only their own specific interests, but have extra-enterprise aims that are external in origin, and are the result of political choices. Some of these are non-economic, social objectives, and a large part of them can be considered "macro-economic". The latter can affect several aspects of the national economy: its growth, the distribution of resources, specific budget policies, the balance of payments, the degree of the national industry's technological development, and the quality of the human capital employed.[9] State-owned firms' extra-enterprise purposes may not be so different from those of internal firms, but usually, given that the nature and timing of research and development programs are subject to government approval, they can turn out to be different from what the enterprise considers to be its aims. If, in theory, state-owned firms' pursuit of extra-enterprise targets can have positive effects on national industrial systems, and stimulate catch-up processes, in some circumstances it can also become a trap that in the long run prevents the pursuit of development programs.[10]

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7 Joseph A. Camilleri, *The State and Nuclear Power: Conflict and Control in the Western World* (Seattle: University of Washington Press, 1984); Benjamin K. Sovacool and Scott V. Valentine, *The National Politics of Nuclear Power: Economics, Security and Governance* (London-New York: Routledge, 2012).

8 Giovanni Paoloni, "Gli esordi del nucleare", in *Storia dell'industria elettrica in Italia*, vol. 4, *Dal dopoguerra alla nazionalizzazione 1945-1962*, ed. Valerio Castronovo (Roma-Bari: Laterza, 1994), 383-407; Barbara Curli, *Il progetto nucleare italiano (1952-1964): Conversazioni con Felice Ippolito* (Soveria Mannelli: Rubbettino, 2000).

9 Venkata Vemuri Ramanadham, *The Economics of Public Enterprise* (London: Routledge, 1991), 72-97.

10 Daron Acemoglu, Philippe Aghion, and Fabrizio Zilibotti, "Distance to Frontier, Selection and Economic Growth", *Journal of European Economic Association* 4, no. 1 (2006): 37-74.

Some scholars have recently highlighted the role the state has played in promoting the expansion of many high-technology sectors, supporting basic research or funding expensive projects with a high risk of failure. The result of these policies has been the introduction of technologies subsequently adopted by private enterprises, both in capital-intensive sectors and in the production of mass consumer goods. In particular, these studies have underlined the importance mission-oriented funding and procurement have, along with the ability to bring together multiple protagonists, leading them toward shared objectives. According to these interpretations, the success of the entrepreneurial state lies in its ability to overcome market and policy uncertainty, in other words to reach a strong consensus on policies as such.[11]

The same scheme could be applied to state-owned enterprises. The design of widely shared strategies is, in fact, imperative to maintain an adequate level of funding and prevent the diversion of resources for political reasons. From this point of view, the development of Italian state-owned firms after World War II is illustrative: while they did not directly produce innovation, they were very effective in promoting the renewal of the managerial elite's technical knowledge and in importing technology. During the 1950s, huge public investment plans led to the modernization of entire industrial sectors. First, they led to the renewal of the steel industry,[12] and important changes were introduced in other strategic sectors as well, namely the mechanical, transport, and telecommunications industries.[13] In many cases, these policies did not lead to innovation in the narrow sense of the term, but by acquiring technology abroad the Italian industry underwent a process of modernization.[14] The existence of a widely shared vision of development, in terms of the pattern of technological innovation to follow, along with the international

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11 Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (London-New York: Anthem Press, 2014).

12 Gian Lupo Osti, *L'industria di Stato dall'ascesa al degrado. Trent'anni nel gruppo Finsider. Conversazioni con Ruggero Ranieri* (Bologna: il Mulino, 1993); Ruggero Ranieri, "Steel and State in Italy and the UK: The Public Sector of the Steel Industry in Comparative Perspective (1945-1956)", in *European Yearbook of Business History*, vol. 2 (Aldershot-Brookfield: Ashgate, 1999), 126-54.

13 Andrea Colli, "La grande stagione dell'IRI", in *Storia dell'IRI*, vol. 2, *Il "miracolo" economico e il ruolo dell'IRI*, ed. Franco Amatori (Roma-Bari: Laterza, 2013), 58-150; Sergio Mariotti, "Le telecomunicazioni: dal monopolio tecnologico ai mutamenti degli anni Ottanta e Novanta alla privatizzazione", in *Storia dell'IRI*, vol. 5, *Un gruppo singolare: settori, bilanci, presenza nell'economia italiana*, ed. Franco Russolillo (Roma-Bari: Laterza, 2015), 201-76.

14 Fabio Lavista and Ferruccio Ricciardi, "Le nuove funzioni d'impresa: formazione, comunicazione, ricerca e sviluppo", in *Storia dell'IRI*, vol. 2, *Il "miracolo" economico*, ed. Amatori, 313-72; Cristiano Antonelli, Federico Barbiellini Amidei, and Claudio Fassio, "L'IRI, la ricerca, lo sviluppo tecnologico, la crescita (1950-1994). Esternalità e governo della conoscenza", in *Storia dell'IRI*, vol. 5, *Un gruppo singolare*, ed. Russolillo, 839-918.

financial aid available through the Marshall Plan, allowed public companies to carry out their objectives.[15]

Given its characteristics (the technologies adopted, the strategic interests involved, the opportunity of having access to international forms of aid aimed at promoting its peaceful applications), the nuclear energy industry could have followed a similar path. In practice, though, its evolution was radically different, mainly because of the lack of definite public choices, in terms both of industrial and foreign policies. The following pages aim to demonstrate this hypothesis, through a study of ENI, which in the mid-1950s developed one of the most promising Italian electro-nuclear projects.

The Italian Government's Nuclear Policy during the 1950s

In the early 1950s, hydroelectric power plants provided almost 89 per cent of Italy's electricity. However, hydroelectric energy was close to exhaustion, given that 70 per cent of it had already been or was about to be exploited. One alternative would have been to extend the use of thermal power stations, but this would have meant an increased dependence on fuel imports.[16] In the first half of the 1950s, similar estimates and reasoning led the Italian government to consider developing nuclear energy. In 1946, the Centro Informazioni Studi ed Esperienze (CISE),[17] a private research center for the peaceful use of nuclear energy, had been created, with the aim of building a first power plant; in 1952, the Italian government established the aforementioned CNRN, with the task of supporting and coordinating – through research contracts – the activities of the CISE and of the Istituto Nazionale di Fisica Nucleare (INFN), an inter-university research institute founded in 1951, and promoting several other initiatives in the nuclear field.[18]

At first, the Italian government was reluctant to start a public debate on nuclear energy. The approval of the decree that led to the creation of the CNRN was mostly due to the pressure exerted on the executive by the community of physicists. A greater government and public involvement in this area became unavoidable after Dwight D. Eisenhower's December 1953 speech in front of the United Nations General Assembly,

15 Francesca Fauri, *Il Piano Marshall e l'Italia* (Bologna: il Mulino, 2010).

16 Gino Martinoli, "Previsioni sullo sviluppo delle Centrali Nucleari di potenza in Italia, in un quadro tecnico-industriale", paper presented at the annual FNAEM congress, Rome, February 26, 1959, 4-5, Fondazione CENSIS, Roma, Carte Martinoli, b. 7, fasc. 1.

17 CISE was established by some of the main Italian large-size enterprises active in the mechanical, chemical and electrical sectors: Azienda elettrica milanese, Cogne, Edison, Falck, Fiat, Montecatini, Pirelli, Sade, and Terni.

18 Paoloni, "Gli Esordi Del Nucleare", 381-89.

and the subsequent International Conference on the Peaceful Uses of Atomic Energy, held in Geneva in 1955, which initiated international financial and technical forms of cooperation in the nuclear field[19].

The political debate on nuclear energy, however, began at a very difficult juncture. In the mid-1950s, the crisis of the political alliance that had ruled Italy since 1947 reached its peak, and was followed by a long political negotiation, which sought to enlarge the ruling majority, built around the Democrazia Cristiana (DC). Negotiations lasted until the beginning of the 1960s and led to the inclusion into the government of the Partito Socialista Italiano (PSI), which in the previous decade had already promoted some major changes in Italy's economic policy. The struggle between the various factions of the DC led to the progressive abandoning of the forms of financial stabilization that had been followed since 1947, and to the approval of the first national economic planning policy. In January 1955, Christian Democrat Ezio Vanoni, who at the time was Finance Minister in Mario Scelba's government, presented a ten-year plan for employment and income growth.[20] As we will see, these new political orientations deeply influenced the nuclear debate. There is another element that has to be taken into consideration in analyzing the beginning of the Italian nuclear program: the proposal of nationalizing the entire energy sector. The idea of nationalizing the electrical industry for anti-monopolistic purposes had already been debated during the Fascist period. Immediately after World War II, it had received support from leftist parties and unions, and at the end of the 1950s it became a major political issue, given that the PSI considered it an unavoidable element to participate in an alliance with the DC.[21] Even before the establishment of the alliance between the PSI and the DC, the debate over the structure of the national energy industry was at the top of the political agenda. In particular, its reorganization was a programmatic point of Amintore Fanfani's second government (July 1, 1958 – February 15, 1959), an issue that, as we will see below, deeply influenced ENI's behavior.

At the beginning of the 1950s, there were two contestants in the Italian energy sector. First, private producers of energy, led by Edison, one of the founders of CISE, which entered the nuclear sector with the intention of thwarting the nationalization project or, at least, of minimizing the consequences of a political decision by meeting the country's

19 Hewlett and Holl, *Atoms for Peace and War*, 209-37.

20 Ezio Vanoni, *Discorsi sul programma di sviluppo economico* (Roma: Istituto poligrafico dello Stato, 1956); Vanoni, *La politica economica degli anni degasperiani. Scritti e discorsi politici ed economici*, ed. Piero Barucci (Firenze: Le Monnier, 1977); Bruno Bottiglieri, *La politica economica dell'Italia centrista 1948-1958* (Milano: Edizioni di Comunità, 1984), 197-328; Fabio Lavista, *La stagione della programmazione. Grandi imprese e Stato dal dopoguerra agli anni Settanta* (Bologna: il Mulino, 2010), 104-38.

21 Giorgio Mori, "La Nazionalizzazione in Italia: il dibattito politico-economico", in *La nazionalizzazione dell'energia elettrica. L'esperienza italiana e di altri paesi europei, Atti del Convegno internazionale di studi del 9-10 Novembre 1988 per Il XXV anniversario dell'istituzione dell'Enel* (Bari: Laterza, 1989), 91-115.

energy needs. Second, public enterprises working in the energy field, namely the firms of the Istituto per la Ricostruzione Industriale (IRI), controlled by the electric sub-holding Finelettrica, and the companies affiliated to ENI.

At first the Italian government, following the new planning policy introduced in the years 1954-1956, favored the cooperation among state-owned enterprises. An effort clearly testified by a meeting of the Committee of Ministers for the development of employment and income – the inter-ministerial body in charge of implementing the Vanoni Plan – held in Rome in October 1956. On that occasion, Prime Minister Antonio Segni, a Christian Democrat, who at that time was also President of the Committee, underlined "the need for Italy to start an industrial activity to produce nuclear energy". Giuseppe Medici (Ministry of the Treasury), Guido Cortese (Ministry of Industry and Commerce) and Emilio Colombo (Ministry of Agriculture and Forests) supported Segni's statement. All agreed that, given the advancement of research in the field of peaceful uses of nuclear energy in Western bloc countries, Italy should have kept itself updated. At the end of the meeting, the Committee decided that ENI – whose president, Enrico Mattei, had been invited in order to illustrate ENI's future investment plans – should have carried out the exploration and production of radioactive minerals, using one of its subsidiaries, Somiren. ENI would have drafted a new industrial plan to process radioactive materials, prepare nuclear fuel and regenerate nuclear fuel. Together with IRI, ENI would have been in charge of building a nuclear power plant in Southern Italy providing energy to Finelettrica, which in turn would have distributed and marketed electric power. In addition, the Committee authorized ENI to join Fiat and Montecatini – two private firms – in the construction of a second power plant in Northern Italy.[22]

The Italian government, therefore, decided to promote the growth of the nuclear sector in the context of the development policies started with the Vanoni Plan, assigning a key role to state-owned enterprises, which would have cooperated among each other and with private companies. In the following years, however, things took a different turn: the six years that elapsed between the 1956 meeting of the inter-ministerial committee and the 1962 approval by the Parliament of the nationalization of the electric industry – years in which the building of the first three Italian nuclear power plants was started – were characterized by a fierce political struggle. The political deal on nuclear energy was drafted in a context that favored contrasts not only between private and state-owned enterprises – respectively "victims" and beneficiaries of a possible nationalization –, but also between

22 Draft of the Comitato dei ministri per lo sviluppo dell'occupazione e del reddito nel quadriennio 1957-1960's meeting, Rome, October 11, 1956, Archivio Storico ENI, Pomezia (Roma) (hereafter ASE), ENI, BG.III.6, f. 1.

different public holdings, which started to pursue competitive development strategies in the nuclear field.

While political uncertainty influenced the decisions of the protagonists, two international elements should also be taken into consideration: first, the difficulties enterprises active in such an unknown and risky sector had to face in order to raise capital from international financial markets. Second, the international political and economic forms of pressure carried out in favor of different technological options. The United States and Great Britain fought for dominance in the field of nuclear reactors, and in the case of the United States, economic objectives went hand in hand with strategic needs tied to Cold War power politics.[23]

ENI's Strategy

Considering this context, it is interesting to follow the evolution of ENI's strategies, given that political uncertainty and the absence of a clear political will deeply influence the operations of this state-owned company. Its actions are in some ways paradigmatic of how the protagonists of the nuclear sector operated in that period. In fact, ENI decided to enter this new field mainly for extra-enterprise objectives and tried to leave as soon as the political framework changed, putting an end to its projects.

In order to understand this behavior, one has to keep in mind that in the mid-1950s ENI was in the midst of an intense growth phase. Once Mattei assured ENI control over the natural gas fields discovered in Northern Italy, he tried to increase the company's access to international oil sources. While it was struggling to control the nuclear sector, ENI signed two of its most controversial oil deals, namely an agreement with Reza Pahlavi of Iran and one with Gamal Abdel Nasser of Egypt.[24] As a result of this expansion strategy, ENI increased its financial commitment and experienced growing international tensions, especially with the United States, which accused the Italian company of challenging its interests in Italy, with the legal monopoly it established on natural gas resources in Northern Italy, and abroad. At an international level, the economic contrasts resulting from ENI's strategy, whose aim was to decrease oil prices, soon turned into political tensions, given that the company's agreements challenged consolidated

23 Robin Cowan, "Nuclear Power Reactors: A Study in Technological Lock-In", *The Journal of Economic History* 50, no. 3 (1990): 541-67.

24 Marcello Colitti, *Energia e sviluppo in Italia. La vicenda di Enrico Mattei* (Bari: De Donato, 1979); Daniele Pozzi, *Dai gatti selvaggi al cane a sei zampe. Tecnologia, conoscenza e organizzazione nell'Agip e nell'Eni di Enrico Mattei* (Venezia: Marsilio, 2009).

international balances, grounded on a static repartition of expenses, profits and roles between big international oil companies and producing countries.

Until that moment, ENI's national and international strategies were successful, thanks to Mattei's and his staff's political abilities and the support of Vanoni, to whom Mattei was closely tied, both politically and personally.[25] Vanoni's sudden death in February 1956 opened up a difficult political period for ENI, as its orientation became more and more dependent on the temporary alliances Mattei was able to establish. With Vanoni gone, Mattei's political points of reference were DC members Fanfani and Giovanni Gronchi, with their neo-Atlanticist foreign policy.[26] In this framework, ENI's nuclear strategy, which was intended to ensure Italy's energy independence, became a prerequisite for a more independent foreign policy.

This, however, is only part of the story, since Mattei half-heartedly decided to enter the nuclear sector. As we have seen, the initial input came from the Committee of Ministers in charge of carrying out the Vanoni Plan. Mattei was eager to comply with the Committee's solicitations, because in the same months the government was discussing a reorganization of the energy sector, which would have led to the creation of a new all-embracing public energy agency, the Ente unico per l'energia. By becoming involved in the nuclear sector, ENI would have been in a more favorable position than IRI, in case the project would have been approved. The Italian government started talking explicitly about this a few months before the 1958 political elections. As an internal ENI report noted, the plan was part of the DC's political agenda and of the agreement signed by the DC and the Partito Social-Democratico Italiano (PSDI), the two political parties that after the elections formed Fanfani's second government. The project was also mentioned in the keynote speech Fanfani gave to the Parliament, after he was appointed Prime Minister. The DC clearly stated in its electoral program that public energy holdings were crucial in achieving a balance between public and private enterprises, assuring the exploitation of national energy sources and promoting economic development. After the establishment in 1956 of the Ministero per le partecipazioni statali,[27] the government program became even more explicit: the document referred to the need for ENI and IRI of introducing a series of reforms, aimed at "obtain a clearer distribution of tasks

25 Fabio Lavista, *Analisi economica, politica estera e sviluppo. Giorgio Fuà, l'ufficio studi dell'Eni e la governance delle partecipazioni statali* (Bologna: il Mulino, 2016).

26 Anna Bedeschi Magrini, "Spunti revisionistici nella politica estera di Giovanni Gronchi presidente della Repubblica", in *L'Italia e la politica di potenza in Europa (1950-1960)*, ed. Ennio Di Nolfo, Romain H. Rainero, and Brunello Vigezzi (Milano: Marzorati, 1992), 59-73; Agostino Giovagnoli and Luciano Tosi, eds., *Amintore Fanfani e la politica estera italiana: atti del convegno di studi tenuto a Roma il 3 e 4 febbraio 2009* (Venezia: Marsilio, 2010).

27 Fabio Lavista, "Dallo statuto del 1948 alla programmazione economica nazionale", in *Storia dell'IRI*, vol. 2, *Il "miracolo" economico*, ed. Amatori, 523-61.

between the two holdings; establish a more efficient managerial control, in order to enhance their economic performances and guarantee a coherent development program, subordinate to central authorization mechanisms; organize state-owned enterprises in a new central bargaining agency; and, finally, allow some form of profit sharing, involving workers in decision processes". The agreement, which was clearly grounded on the primacy of politics, also included the possibility of merging all state-owned enterprises working in the research, production and distribution of energy into a new public holding. As ENI's report pointed out, Fanfani's keynote speech offered a deep insight into the project. It underlined the need to "distribute competencies and enterprises between ENI and IRI more efficiently", and merge their electric subsidiaries into a new holding, to which the two companies would have transferred their long-term concessions for the exploitation of energy sources and which would have used its profits to acquire new concessions.[28]

In the following months, the new holding was not created. The struggle inside the DC, stirred up by Fanfani's attempt to include the PSI in the government, led to the project's failure.[29] The nationalization of the energy sector would have been carried out only a few years later, under the first centre-left coalition government, in a profoundly different context and following a different procedure. For some time, though, it seemed possible that ENI could became the new holding as proposed by the DC's political program.

After the creation in the first half of the 1950s of Somiren – an enterprise active in nuclear fuel research –, and the founding in 1956 of AGIP Nucleare, placed under the supervision of Gino Martinoli, ENI started to hire and train new personnel; study the nuclear technologies available on the international market; and build – not by chance in 1958 – a first nuclear power plant in Latina (near Rome), after signing an agreement with the British Nuclear Power Plant Company (NPPC).[30] As we will see in the following paragraph, two aspects of this story are particularly interesting, as far as the relationships between political uncertainty and technological development is concerned. First, the fact that the survey on available technologies led ENI to draft a development plan that went far beyond the construction of a single power plant, a plan tailored for a public holding that was ready to manage the whole electric sector. The second interesting aspect is ENI's decision to opt for British technology, a decision that was grounded in the need to diversify nuclear technologies, given that the other Italian enterprises active in those years in the nuclear sector used US technology. Since British nuclear power plants

28 See *Appunti sulla costituzione di un Ente nazionale dell'energia*, 1958, ASE, ENI, BG.III.6, b. 2.

29 Giorgio Galli, *Storia della Democrazia Cristiana* (Bari: Laterza, 1978), 183-205.

30 Mauro Elli, *Atomi per l'Italia. La vicenda politica, industriale e tecnologica della centrale nucleare ENI di Latina 1956-1972* (Milano: Edizioni Unicopli, 2011).

were fueled by natural uranium, whereas American ones relied on enriched uranium, which could only be enriched by US enterprises, such a choice would have assured Italy a more independent future.[31]

Political Uncertainty, at Home and Abroad

The peculiar development of the Italian nuclear sector during the 1950s and the 1960s led to the building of three nuclear power plants, each designed following a different technology: thanks to a loan granted to it by the Export-Import Bank, Edison signed an agreement with Westinghouse to buy an enriched uranium reactor, moderated with pressurized water. IRI participated in the research project Energia Nucleare Sud Italia (ENSI), which was promoted by the CNRN and received funding from the International Bank for Reconstruction and Development (IBRD); the enterprise signed an agreement with General Electric to build a second enriched uranium reactor, moderated in this case with boiling water. Finally ENI, using its own financial resources, signed an agreement with NPPC in order to build a natural uranium reactor, graphite-moderated.[32]

The diversification of the nuclear industry was partly justified by the immaturity of the technology, given that it was impossible to know in advance which technological pattern the nuclear sector would have followed. However, this decision led to a scattering of resources and to an almost complete lack of synergies, with negative effects on the further developments of the field. Some protagonists have argued that this dispersion of resources was the outcome of a "feud" between the main actors of the Italian nuclear industry, who focused their efforts on gaining a favorable position in the case of a reorganization or nationalization of the industry.[33] The main responsibility for the development of the sector, though, was undoubtedly political.

The story of the Italian nuclear industry took place in a very unstable political environment, both nationally and internationally. In ENI's case, this uncertainty explains the choices – especially the technological ones – made by the public holding. If one considers the possible future developments of the sector, the agreement signed with NPPC was a rational choice, given that at the time Euratom was supporting research programs aimed

31 See internal report on different nuclear technologies written on the occasion of a Mattei's trip to Great Britain, May 1957, ASE, ENI, H.III.2, b. 35.

32 Paoloni, "Gli esordi del nucleare".

33 Mario Silvestri, *Il Costo della menzogna. Italia nucleare 1945-1968* (Torino: Einaudi, 1968); Colitti, *Energia e sviluppo in Italia*; Carlo D'Amicis and Mirella Fulvi, eds., *Conversando con Gino Martinoli* (Roma: Fondazione Adriano Olivetti, 1991); Curli, *Il progetto nucleare italiano*.

at evaluating the possibility of developing the gas/graphite technology.[34] However, the plan Martinoli drafted for AGIP Nucleare did not focus only on the use of this technology. In the same months in which it tried to reach an agreement with the British nuclear authorities, ENI tried to sign a similar cooperation agreement with the US firm Babcock & Wilcox. Its aim was to build a second nuclear reactor moderated with pressurized water, in compliance with the directives received in 1956 by the Committee of Ministers for employment and income.[35] The decision to focus only on British technology came later, between 1957 and 1958, and it was not the result – as some scholars have argued – of Mattei's hostility toward the United States, but rather of domestic and international political pressures.

Some telegrams sent by the US embassy in Rome to the State Department in May 1957 leave little doubt about the nature of these pressures. Two days after the resignation of Segni's government – the one that assigned IRI and ENI the task of building two nuclear power plants, one in the Northern and one in Southern Italy –, Ambassador James David Zellerbach informed the State Department that even before the government crisis, "efforts [had] been made [by Italian officials]: a) to convince Mattei that AGIP Nucleare [had] no business in the electric power field but should [have confined] activities to search for uranium, b) should Mattei and supporters [have insisted] on entering the power field to try to convince them to buy Calder-Hall type plants [the British nuclear power plant type]". Therefore, in 1957 there were several national interests that were putting pressure so that ENI would not have entered the nuclear sector or, at least, that it would not have entered it thanks to an agreement with the United States. The telegram stated that, "foreign and career officers and other interested ministers [believed] SEN [AGIP Nucleare's competitor, controlled by IRI and private enterprises] [was] the logical group to represent the State in this field". As a matter of fact "knowledge that AGIP-Nucleare could not [have obtained] a world bank loan [figured] heavily among the reasons for favoring SEN".[36] International ostracism against ENI undoubtedly favored IRI and private enterprises: just ten days later, Zellerbach confirmed that "both the foreign office and CNRN [were] opposing AGIP entrance (Mattei) in the nuclear energy field and the earlier report of SEN to the Babcock Wilcox project was the first step in this campaign".[37] The new government (May 19, 1957 – July 1, 1958),

34 See *Partecipazione dell'Euratom a reattori di potenza*, May 2, 1961, ASE, ENI, I.V.4, b. 280.

35 See *Osservazioni sul programma di sviluppo dell'energia nucleare*, Roma, March 8, 1957, ASE, ENI, H.III.5, b. 84.

36 See telegram by James David Zellerbach to State Department, May 17, 1957, National Archives and Records Administration, Washington, DC (hereafter NARA), General Records of the Department of State, Central Decimal File 1955-1959, b. 2541, f. 611.6597/1-3157, d. 611.6597/5-1757.

37 See telegram by James David Zellerbach to State Department, May 27, 1957, NARA, General Records of the Department of State, Central Decimal File 1955-1959, b. 2541, f. 611.6597/1-3157, d. 611.6597/5-1757.

largely controlled by the DC and placed under the direction of Adone Zoli, along with the CNRN, took advantage of the possibility of accessing international funding, and granted precedence to SEN in signing an agreement with a US corporation.

The strategy pursued by the US government is clearly explained in a third telegram that Zellerbach sent to the State Department two days later, while Mattei was in London to negotiate a deal with the British nuclear agency. Zellerbach hoped that Mattei's trip would be successful because: "1) Mattei would thereby [have removed] himself from contention over concrete US projects and thereby [have] immensely [simplified] the task of getting on with these projects, and 2) there was a reason to believe that [the Italian government] would [not have approved] 'any time soon' another ENI loan of magnitude necessary to finance the Calder-Hall project in which event Mattei would [have been] out on atomic power business where he belonged".[38] Therefore, after supporting the agreement between Edison and Westinghouse with the aim of limiting public intervention in the electric sector, the US government also supported the agreement that led to the ENSI project. This included IRI, but not ENI, and could be considered part of a well-established tradition of international aid granted by the IBRD to Southern Italy.[39] By doing so, the US government achieved several aims: it helped private electric enterprises, it offered its support to the development policies Italian governments had been promoting since the approval of the Vanoni Plan,[40] and it excluded ENI. For the Italian public holding, opting for British technology became the only feasible alternative.

The reasons behind the US government's hostility to ENI went beyond competition in the nuclear sector. However, the US strategy would have been less successful if the Italian government had had a clearer policy for the development of a national nuclear industry, as it had done in the oil field, where ENI was able to gain more leeway.[41] In this context, Mattei was forced to follow multiple strategies: a few months after the aforementioned political skirmishes, and after Zoli's government resigned and was substituted by Fanfani's second government, ENI's President came close to becoming chairman of the new Ente unico per l'energia. The crisis of Fanfani's government a few months later led to a temporary dismissal of the plans to reorganize the electric industry. In this context, it was clear that the plan promoted by Martinoli for AGIP Nucleare would be

38 See telegram from James David Zellerbach to State Department, May 29, 1957, NARA, General Records of the Department of State, Central Decimal File 1955-1959, b. 2541, f. 611.6597/1-3157, d. 611.6597/5-1757.

39 Leandra D'Antone, "Straordinarietà e stato ordinario", in *Storia del capitalismo italiano dal dopoguerra ad oggi*, ed. Fabrizio Barca (Roma: Donzelli, 1997), 579-625.

40 Barbara Curli, "Energia nucleare per il Mezzogiorno. L'Italia e la Banca Mondiale (1955-1959)", *Studi Storici* 37, no. 1 (1996): 317-51.

41 Pozzi, *Dai gatti selvaggi*, 307-458; Lavista, *Analisi economica*, see fourth chapter.

of little interest for Mattei, while oil would continue to be ENI's core business. This was a field that started registering a rapid increase in investments, just as ENI was entering into the nuclear sector. As a result, the company became unwilling to immobilize huge financial resources in the nuclear field.

ENI's growing indebtedness (see Figure 1) explains its progressive disengagement from nuclear energy, starting in 1959. The process began with the firing of Martinoli and the resizing of his development plan; it was followed by a suit against NPPC, aimed at reducing the cost of the Latina nuclear power plant, which had already started to be built; and by the attempt to sell the plant to IRI, even before the government made a decision on the nationalization of the energy sector.[42]

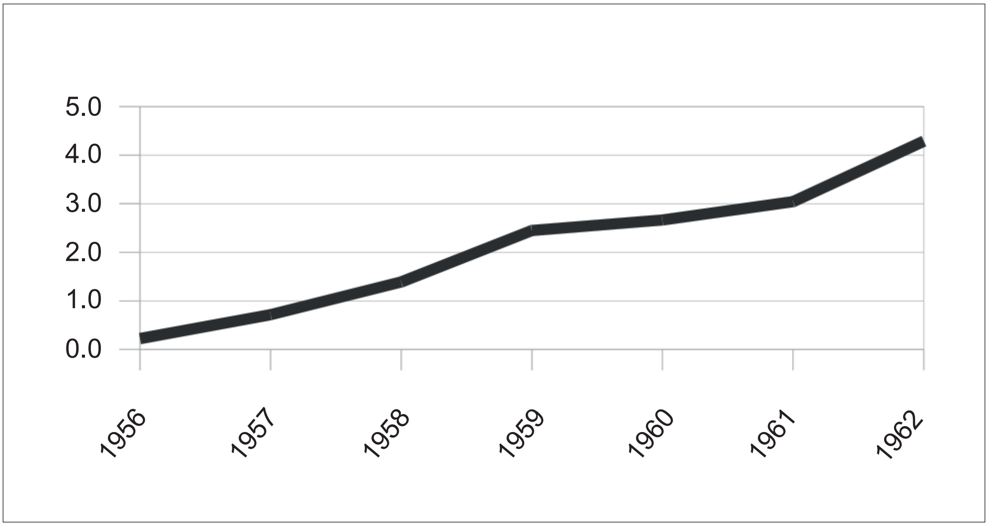

Figure 1: ENI's debt to net worth ratio, 1956-1962. Source: ENI's financial statements, various years.

Conclusion

Despite ENI's success in the building of the Latina nuclear power plant (in 1963 it was the first active plant in Italy), it soon became evident that the nuclear field could not become a priority for this public group. Given the political context described above, even other protagonists of the nuclear industry found it difficult to develop their policies.

42 Elli, *Atomi per l'Italia*, 75-95.

The turbulent international context, coupled with political uncertainty at a national level, deeply influenced the decision processes of both public and private enterprises. On the one hand, international forms of pressure affected their decisions concerning international partnerships and this, in turn, had important consequences on the technological evolution of the sector. On the other hand, uncertainty negatively influenced companies' levels of investment. Given that the Italian government did not offer any reassurance about its support for nuclear programs, enterprises active in the energy industry limited their efforts in the nuclear field. Even the Ente Nazionale per l'Energia Elettrica (ENEL), the energy agency created in 1962 with the nationalization of the energy sector, limited its investments in the nuclear field and decided to focus its efforts on managing the investments made by other firms during the 1950s.

Considering these developments, we can conclude that the evolution of the Italian nuclear sector during the 1950s confirms two initial assumptions: the success of public intervention rests on the ability to overcome not only market, but also political, uncertainties; this ability is one of the most important prerequisites for technological development.

Barbara Curli

Italy, Euratom and Early Research on Controlled Thermonuclear Fusion (1957-1962)*

ITER, the international controlled thermonuclear fusion project, is the world's largest fusion experiment and the most important European research project, apparently "one of the largest and most expensive science projects ever",[1] and also a very controversial one. The European Union (with Switzerland) participates for around 46 per cent of total costs and the other six partners (Japan, China, Korea, the Russian federation, India and the United States) for around 9 per cent each. The ITER device, "approximately three times as heavy as the Eiffel Tower", is a tokamak currently under construction at Cadarache, in the South of France.[2] Italian research and Italian industry extensively participate in the ITER project,[3] which is also intended as an industrial policy tool to support research and development in advanced technology on a European scale.[4] The

* Although this research is at a very preliminary stage, I wish to thank the people and institutions that greatly contributed to its beginning: Aldo Pizzuto, Head of Unità tecnica fusione of ENEA, Centro Ricerche di Frascati, and his associates, Vincenzo Vitale and Giulia Bartolomei, for their collaboration and warm hospitality in Frascati; Gianni Battimelli, for his friendly guidance in the Archives of the Department of Physics of "La Sapienza" University, Rome; Franca Magistrelli, Carlo Bernardini and Romano Toschi for their helpful insights into the early phases of the Frascati project; Odile Frossard and Sophie Delmas at the Archives historiques du Commissariat à l'énergie atomique, Fontenay-aux-Roses, France; and John Krige for kindly sharing his unpublished work on nuclear fusion.

1 W. Patrick McCray, "'Globalization with Hardware': ITER's Fusion of Technology, Policy, and Politics", *History and Technology* 26, no. 4 (December 2010): 283-312.

2 Fusion for Energy, *Annual Report 2014*, http://www.fusionforenergy.europa.eu/mediacorner/annualreport.aspx, last accessed April 19, 2016.

3 Aldo Pizzuto, "La partecipazione italiana al programma internazionale per la fusione", *Italian ITER Business Forum*, Milan, June 26, 2014, http://www.iibf2014.enea.it/, last accessed April 19, 2016; Paolo Acunzo, "La partecipazione delle industrie italiane al progetto ITER/Fusion for Energy", paper presented at the conference *ITER: un'opportunità per le aziende piemontesi*, Turin, November 16, 2015, http://www.confindustria.piemonte.it/convegni-ed-eventi/2444-iter-un-opportunita-per-le-aziende-piemontesi-torino-16-novembre-2015, last accessed April 19, 2016.

4 European Commission, Directorate general for Research, Fusion Energy Research, *Fusion and Industry together for the Future* (Luxembourg: Office for Official Publications of the European Communities, 2009).

Frascati Tokamak Upgrade (FTU), one of the seven tokamaks currently operating in Europe, which developed from a first generation prototype, the Frascati Tokamak (FT), set in operation in 1977, is located in the Frascati National Laboratories of the Comitato Nazionale per la ricerca e lo sviluppo dell'Energia Nucleare e delle Energie Alternative (ENEA), the national agency for new technology and energy. Italian industry (e.g. Ansaldo) also has a long tradition of presence in nuclear fusion and industrial application.[5]

Both European collaboration in controlled thermonuclear fusion research and Italian involvement in this field have in fact a long history, which goes back to the early days of the European Community, but has been underexplored so far. This chapter is intended as a preliminary contribution to the historical reconstruction of the early steps of European cooperation in nuclear fusion, with particular emphasis on Italian participation.[6] This chapter is part of a larger research project on the history of European research in nuclear fusion: here, we will limit ourselves to outlining the historical background leading to the first association contract between Euratom and the Comitato Nazionale per le Ricerche Nucleari (CNRN), then Comitato Nazionale per l'Energia Nucleare (CNEN), to support the early Italian effort in the field.

The History of Controlled Thermonuclear Fusion: Some Methodological Remarks

Historiography on fusion is still scarce, and mainly concerns the American case.[7] Limited access to archives, on nuclear energy in general, and on nuclear fusion in particular, partly explains the difficulties to be encountered in any scholarly reconstruction of fusion history. Most available literature deals with fusion either in the framework of future energy prospects,[8] or is limited to popular science books,[9] even to futurology.[10]

5 ENEA, *1960-2010: 50 anni di ricerca sulla fusione in Italia*, ed. Paola Batistoni (Frascati: ENEA-Edizioni Scientifiche, 2010).

6 We adopt here "fusion" as a simplified term for "controlled thermonuclear fusion", which would be the correct expression.

7 Joan Lisa Bromberg, *Fusion: Science, Politics, and the Invention of a New Energy Source* (Cambridge, MA: MIT Press, 1982).

8 *Fusion*, ch. 12, in Richard Muller, *Energy for Future Presidents: The Science behind the Headlines* (London: Norton, 2012), 199-218.

9 Garry McCracken and Peter E. Stott, *Fusion: The Energy of the Universe* (Oxford: Elsevier, 2005, 2nd ed. 2013); Charles Seife, *Sun in a Bottle: The Strange History of Fusion and the Science of Wishful Thinking* (New York: Viking, 2008); Robin Herman, *Fusion: The Search for Endless Energy* (Cambridge: Cambridge University Press, 1990).

10 Michio Kaku, *Physics of the Future: How Science Will Shape Human Destiny and Our Daily Lives by the Year 2100* (New York: Doubleday, 2011).

A series of books written by experts and protagonists are rich and informative, though they rarely escape some rhetorical, even lyrical, tone, related to the symbolic nature of fusion energy.[11] Apart from obvious questions arising from current events (the ITER project), which in themselves would indeed justify intellectual curiosity on the historical background of European fusion, there are several additional reasons for a historical research on the subject.

The first concerns the specificity of the European experience. Research on thermonuclear fusion had military origins (fusion being the principle on which the H bomb is based) and early ideas developed in American and British laboratories during and immediately after World War II. Research was then boosted in the early 1950s as a consequence of the announcement of the first Soviet atomic bomb in 1949, soon setting up a competition between the United States, the United Kingdom and the Soviet Union on which one would be the first nation to achieve nuclear fusion.

In Europe, where no single country would be able to carry out alone an effort in the field, research on nuclear fusion developed from the very beginning in the Community framework of Euratom. All national research evolved under Euratom's heading: in this respect, nuclear fusion is probably the only example of a truly "common" European policy and of a sector almost completely *euratomisé*, to use Jules Guéron's expression. This does not mean that there are no national programs. The Europeanization of techno-scientific research is not to be seen in contrast to national interests, but rather as also the pursuit "of one's interest by other means", that is, by Europeanizing all or part of national efforts.[12]

The history of fusion may indeed contribute to improve our understanding of Euratom's historical experience: usually (though undeservedly) portrayed as a "failure" in the history of European integration – especially if compared to its more successful Rome twin, the European Economic Community (EEC) – Euratom is in fact a still relatively underexplored subject, in particular with regard to the ways its activities were redefined as a consequence of the merger of the executives in 1967.[13] To write a history of fusion is

11 T. Kenneth Fowler, *The Fusion Quest* (Baltimore: Johns Hopkins University Press, 1997); Paul-Henri Rebut, *L'énergie des étoiles. La fusion nucléaire contrôlée* (Paris: Odile Jacob, 1999); Paul Reuss, *L'épopée de l'énergie nucléaire. Une histoire scientifique et industrielle* (Paris: EDP Sciences, 2007); Guy Laval, *L'énergie bleue. Histoire de la fusion nucléaire* (Paris: Odile Jacob, 2007).

12 John Krige, "The Politics of European Scientific Cooperation", in *Companion to Science in the Twentieth Century*, ed. John Krige and Dominique Pestre (1997, Amsterdam-Abingdon: Routledge, 2003), 897-919, quote 900.

13 Olivier Pirotte, *Trente ans d'expérience Euratom. La naissance d'une Europe nucléaire* (Bruxelles: Bruylant, 1988); Michel Dumoulin, Pierre Guillen, and Maurice Vaïsse, sous la direction de, *L'énergie nucléaire en Europe. Des origines à Euratom. Actes des journées d'études de Louvain-la-Neuve, des 18 et 19 novembre 1991* (Berne: Peter Lang, 1994); Gunnar Skogmar, *The United States and the Nuclear Dimension of European Integration* (Houndmills, Basingstoke, Hampshire-New York: Palgrave Macmillan, 2004).

thus to also write a history of the ways Euratom has been transformed overtime, and to look at the political, economic, and cultural dynamics underlying the "Europeanization" of scientific and technological collaboration.[14] As John Krige wrote, Euratom represented a new level of the postwar relationship between the state and *big science* in Western Europe, and its history depicts "the emergence of a new structure and a potent source of funding and of legitimation for expensive fields of scientific research and technical development". Krige lists nuclear fusion (referring to JET, the Joint European Torus) among the seven main fields of techno-scientific cooperation "to be situated at the heart of the process of European economic and political integration".[15]

Euratom's experience in controlled thermonuclear fusion should however also be assessed within the larger context of the role of *big science* in postwar international institutionalism. Euratom is a regional framework, whose activity is constantly in relation to other multilateral institutions in charge of nuclear energy development and control. The fusion experience is thus another example of hybridization and intersection among multiple international institutional levels – European Organization for Nuclear Research (CERN), Organisation for European Economic Co-operation (OECE), International Atomic Energy Agency (IAEA) etc. – and is also related to the important role played by the international Geneva conferences on the pacific uses of atomic energy (in particular that of 1958), and in the specific case of fusion by the international conferences on Fusion and Plasma Theory. Although constantly interacting, however, each of these levels retains its own specificity, both politically and institutionally (as in the case of early cooperation between Euratom and CERN on nuclear fusion, as subsequently analyzed).

Fusion, moreover, played a peculiar role in the technological and scientific Cold War. Although a highly "politicized" sector, though unlikely to yield economic or strategic-military-industrial returns if not in the very long term, research on fusion turned out to be particularly suited to "science diplomacy" practices and to be used as a foreign policy tool across the iron curtain. This role was somehow eased by the undisputed Soviet leadership in the field. According to the Report released in 1966 by the US Atomic Energy Commission (USAEC) on the status of fusion research in the world, as far as manpower involved in the sector the Soviet Union "leads the world": "their effort is twice the US effort. In plasma theory the Soviets are preeminent and at this time their effort in theory is about four times the US effort. In number and variety of major experimental devices the Soviets also lead the world".[16] As will be seen in the next paragraph, starting from the

14 Luca Guzzetti, *A Brief History of European Union Research Policy* (Luxembourg: European Commission, Directorate-General XII Science, Research, Development, 1995).

15 Krige, "The Politics", 897.

16 USAEC, *AEC and Action Paper on Controlled Thermonuclear Research*, June 1966, III-32, http://fire.pppl.gov/US_AEC_Fusion_Policy_1966.pdf, last accessed April 19, 2016.

decision to declassify information announced by the major nuclear powers (the United States, the United Kingdom and the Soviet Union) at the II Geneva conference in 1958, fusion was indeed a scientific field always bearing a "symbolic" value of collaboration which at times helped to cross the rigid logic of the Cold War divide, thereby setting up a long tradition of Euro-Soviet-American cooperation lasting to some extent until today. There is therefore an evident political dimension in the history of fusion that may have affected in different ways decision-making on national and international projects and gone beyond purely scientific considerations.

As a matter of fact, when looking at the history of nuclear fusion one is struck by the continuous exchange among European, American and Soviet laboratories already in the late 1950s and onward. A further element of interest in studying nuclear fusion in a historical perspective is thus to trace the development of a truly transnational (even across the iron curtain) epistemic community of scientists, technicians, technocrats, managers, promoters of science and of techno-scientific policies. At the national level, given the relevant involvement of the state in financing and control, fusion soon appeared as yet another very politicized field of scientific research, subject to bureaucratic management and rivalries, while at the same time "wedded to an ethic of progress and excellence".[17] At the European level, fusion raises a number of additional methodological questions, e.g. whether it is possible to detect a specificity, that is, whether Euratom's regional institutional dimension might have contributed to some peculiar form of "identity" of the European fusion community. The historical experience of the fusion community is thus to be assessed as a contribution to both the social history of nuclear energy, and the history of European integration.[18]

Given the high cost of investment, fusion research developed as a typically public-financed sector, both at a national and at a European level. A study of European fusion history may thus help us to deepen our understanding of the political decision-making processes leading to the investment in research and development on a Community scale and of the rhetoric supporting the development of a 'European public hand' in strategic sectors. In particular, it may help to assess the role of an emerging "fonction publique européenne" in techno-scientific cooperation. In the case of fusion, for example, one should acknowledge the fundamental role played by Donato Palumbo (1921-2011),

17 Steven Goldberg, "Controlling Basic Science: The Case of Nuclear Fusion", *Georgetown Law Journal* 68 (1979-80): 683-725, see 700.

18 Edgar Grande and Anke Peschke, "Transnational Cooperation and Policy Networks in European Science Policy-Making", *Research Policy* 28 (1999): 43-61; Olof Hallonsten, "Continuity and Change in the Politics of European Scientific Collaboration", *Journal of Contemporary European Research* 8, no. 3 (2012): 300-19; Laurence Jourdain, *Recherche scientifique et construction européenne. Enjeux et usages nationaux d'une politique communautaire* (Paris: L'Harmattan, 1995).

an Italian physicist and "a fusion visionary",[19] who from 1958 was in charge of the European Fusion Programme and for many years was its head and key figure. He carried out with unanimously recognized competence and dedication the *contrats d'association*, a new formula whereby Euratom would finance, develop, coordinate and supervise national fusion programs. When Palumbo retired in 1986, 13 contracts were in operation. Both archival documentation and oral sources confirm the key coordinating and stimulating role played by Palumbo,[20] who would himself confess "my total dedication to the European Fusion Programme throughout my 28 years in Brussels".[21]

Finally, a study of fusion is a study of the role played historically by Italian research in the nuclear field and on Italy's position in European techno-scientific cooperation and integration. It provides a further viewpoint from which to explore the relationship between Italy and Euratom, and – more broadly – to assess the patterns of Italian techno-scientific modernization, and its limits. [22] It is also a contribution to a still relatively little known aspect in the history of relations between Italy and France in the nuclear field.

Euratom and the Origins of the European Research Programme on Controlled Thermonuclear Fusion

The possibility of producing energy using the fusion of the isotopes of hydrogen had been first discussed during the war by scientists engaged in the Manhattan Project, and pursued early on in the United Kingdom by George Thompson, professor of physics at the Imperial College in London, and Moses Blackman, who in 1946 produced the first classified patented scheme to confine a plasma using a "pinch effect". To their effort was added that of Peter Thonemann, an Australian physicist working in Oxford, and of James Tuck, a British physicist who participated in the Manhattan Project, and after the war would be called back to Los Alamos to join the team assembled by Edward Teller to launch the program for a hydrogen bomb. The UK Atomic Energy Authority (UKAEA), and the British top nuclear establishment, in particular Sir John Cockroft and Lord Cherwell, thus became convinced that a British program on nuclear fusion

19 Jean Jacquinot, "Donato Palumbo (1921-2011), a Fusion Visionary", *ITER Newsline* 201 (December 2001), http://www.iter.org/newsline/201/977, last accessed April 19, 2016.

20 Harry Bruhns, "In Ricordo di Donato Palumbo (1921-2011)", *Il Nuovo Saggiatore* http://static.sif.it/SIF/resources/public/files/ricordo/palumbo.pdf, last accessed April 19, 2016.

21 Donato Palumbo, "The Work of the European Commission in Promoting Fusion Research in Europe", *Plasma Physics and Controlled Fusion* 29 (1987): 1465-73.

22 Barbara Curli, "L'esperienza dell'Euratom e l'Italia. Storiografia e prospettive di ricerca", in *L'Italia nella costruzione europea. Un bilancio storico (1957-2007)*, ed. Pietro Craveri and Antonio Varsori (Milano: FrancoAngeli, 2009), 211-29.

was needed, as it was indeed launched in 1951, to be developed in the Culham and Harwell laboratories.[23]

The US program was officially launched in 1951 as a classified program, the so-called Sherwood Project, financed and supervised by the USAEC, and carried out in four laboratories: Princeton (directed by Lyman Spitzer Jr.); the Los Alamos Scientific Lab (LASL), directed by James L. Tuck; the Livermore branch of the University of California's Radiation Lab, directed by Herbert York and Richard F. Post; and the Thermonuclear Group of the Oak Ridge National Laboratory; in addition to research carried out in several US universities.[24] Generous funding by the USAEC, which in the mid-1960s provided 23 million dollars out of a total national fusion budget of 40 million dollars (Defense providing an additional 10 and NASA another 5),[25] was intended to support nuclear fusion research, "because of its potential social benefits, and of its close association with the hydrogen bomb project", and in order to maintain "American leadership in nuclear technologies to ensure that the nation had a sound platform in both civilian and military applications".[26] Research on nuclear fusion was thus from the very beginning characterized by the "intermingling of science and politics".[27]

By the mid-1950s, then, although still strictly classified, fusion research was very much at the forefront of the international nuclear discourse and of Cold War techno-scientific and prestige competition, and very well embodying the optimistic ideology of those "années folles"– as Bernard Goldschmidt defined them – of nuclear fervor.[28]

Moreover, the origin of the European Fusion Programme should be assessed in the framework of the international competition between the United States, the United Kingdom and the Soviet Union, and in view of the International Conference on the Peaceful Uses of Atomic Energy held in Geneva in September 1958, where important announcements about nuclear fusion were anticipated. Already in April 1956, during a visit to England by Nikita Khrushchev – the first visit to the West by a Soviet leader – the Soviet physicist Igor Kurchatov (the father of the Soviet atomic bomb, and, with Andrei Sacharov, of the Soviet H bomb), who was a member of Khrushchev's delega-

23 On the British program see also R. S. Pease, "The UK Fusion Programme", *Plasma Physics and Controlled Fusion* 29 (1987): 1439-47.

24 On the origins of the US controlled thermonuclear fusion program see Bromberg, *Fusion*; Stephen O. Dean, "Historical Perspective on the United States Fusion Program", paper presented at American Nuclear Society 16th Topical Meeting on the Technology of Fusion Energy, Madison, WI, September 14-16, 2004, http://fire.pppl.gov/Dean_US_fusion_TOFE_2004.pdf, last accessed April 19, 2016.

25 USAEC, *AEC and Action Paper.*

26 John Krige, "The First Twenty Years of Nuclear Fusion Research", unpublished manuscript.

27 Bromberg, *Fusion*, 2.

28 Bertrand Goldschmidt, *L'aventure atomique. Ses aspects politiques et techniques* (Paris: Fayard, 1962).

tion, gave a very open and in-depth speech at Harwell on questions related to fusion.[29] The speech anticipated the declassification of information related to fusion, which was announced by the United States, the United Kingdom and the Soviet Union at the 1958 Geneva conference. It was evident that such a decision was intended to use international scientific cooperation also as a foreign policy and détente tool.[30]

All these features contributed to the insertion of nuclear fusion among the priorities set by the Treaty establishing the European Atomic Energy Community (Euratom), signed on March 25, 1957. During the negotiations leading to the Treaty, fusion had already been defined "une tache de première urgence".[31] It was listed in Annexe I of the Treaty as a field of research to be carried out by the Commission according to article 4 of the Treaty. Under the heading *Physics applied to nuclear energy,* point e) foresaw "the study of fusion, with particular reference to the behaviour of an ionized plasma under the action of electromagnetic forces and to the thermodynamics of extremely high temperatures".

In order to outline the strategic actions of the new Community, on September 11, 1957 Euratom's Comité intérimaire entrusted a group of experts with the task of establishing a first research program. The group of experts met for the first time in Paris on December 3, 1957 (Amaldi and Felice Ippolito were the Italian members).[32] On that occasion a *Note* presented by the French Delegation was adopted as a basis for discussion. According to the *Note*, which had been prepared by the French Commissariat à l'énérgie atomique (CEA), "le mandat donné au groupe d'experts qui se réunit le 3 décembre 1957 est d'étudier les possibilités d'entreprendre certains travaux préparatoires à l'exécution du programme de recherches d'Euratom. Il semble que l'on puisse, dans ce cadre, examiner les questions suivantes, en vue de s'adresser à la future Commission les recommandations appropriées". Among the priorities listed by the *Note*, were high flux reactors, research prototypes, and nuclear fusion. The aim would be to outline a kind of inventory of activities under way in member countries at that time, in each of these three fields, while waiting for the operational start up of the joint research centre (JRC): "Les premiers travaux de ces groupes d'études devraient permettre de passer commande d'études à faire sous contrat que le Centre commun ne peut espérer faire

29 Igor V. Kurchatov, "The Possibility of Producing Thermonuclear Reactions in a Gaseous Discharge", speech given at Harwell, April 25, 1956, published in *Nucleonics*, June 1956, http://fire.pppl.gov/kurchatov_1956.pdf, last accessed April 19, 2016.

30 United Nations, *Peaceful Uses of Atomic Energy: Fifty Years of Magnetic Confinement Fusion Research, 1958-2008* (Vienna: IAEA, 2008).

31 Groupe de l'Euratom, Rapport du Groupe ad hoc, *Programme et Budget de Recherche*, 3 Janvier 1957, Archivio Edoardo Amaldi, archivio del Dipartimento di Fisica, Università "La Sapienza", Roma (hereafter AAm), sezione Dipartimento di Fisica (hereafter SADF), 175, 2, 1.

32 On Amaldi and Ippolito see forward.

lui-même avant un certain temps". The reason for the insertion of fusion among these priorities was mainly political: according to the French *Note*, "Il convient de se hâter sur les travaux sur la fusion car Américains, Anglais et Russes ont annoncé que ce sera un des principaux sujets de la Conférence de Genève".[33]

Declassification then opened up a new phase in fusion research history and favored the start of the European program within the Euratom framework. No single European country at the time was able to carry out an exclusively national effort, thus there was no competition between a national and a European program, nor questions related to industrial applications (as in the case of fission); and a common program would allow to relieve the costs of research that no single member country would be able to bear individually, in particular in a field still at a very preliminary stage and with very long-term expected experimental results. Fusion seemed thus an ideal field of European co-operation, and one that would strengthen Europe's techno-scientific "identity", rooted in the golden age of faith in the capability of science and technology to orient unlimited progress and social change.[34]

The Group of Experts' Report accepted almost entirely the content of the French *Note* and proposed that the Commission adopted the three above-mentioned fields (high flux reactors, research prototypes, and nuclear fusion), as the first programs to be pursued by Euratom, in addition to the establishment of the JRC. In relation to fusion, the Report underlined:

> la fusion nucléaire constitue le type même de recherche à long terme où un travail en commun est particulièrement souhaitable. Les experts ont été unanymes à reconnaître l'urgence d'une action commune dans ce domaine ou anglo-saxons et russes ont consenti d'importants investissements et semblent attendre des résultats positifs. Les travaux de ce troisième Groupe devraient permettre de confier des contrats de recherche à des laboratoires, publics ou privés, sans attendre la constitution du Centre.[35]

33 *Note de la Délégation française sur les activités de recherche d'Euratom*, Paris le 28 novembre 1957, Archives historiques du Commissariat à l'Energie Atomique, Fontenay-aux-Roses, France (hereafter AHCEA), Archives du Haut-Commissaire à l'énergie atomique (hereafter HC), F5.17.11.

34 On these cultural, discursive features of Euratom's early history, see Barbara Curli, "Nuclear Europe: Technoscientific Modernity and European Integration in the Discourse on Euratom", in *Discourses and Counter-Discourses on Europe: From the Enlightenment to the European Union*, ed. Manuela Ceretta and Barbara Curli (London: Routledge, 2016, forthcoming).

35 Comité intérimaire pour le Marché commun et l'Euratom, *Rapport du Groupe de la Recherche nucléaire*, 4 décembre 1957, AHCEA, HC, F5.17.11.

The Euratom-CERN Joint Work Study Group, 1958-1959

Almost simultaneously, an attempt was made to establish a Euratom-CERN Joint Work Study Group for Fusion Research. The initiative apparently came from François De Rose, the man responsible for Atomic questions at the Quai d'Orsay, who had been the French representative at the IAEA and just appointed (1958) President of the CERN Council. De Rose had approached the President of the Euratom Commission Louis Armand and the director of Research and Education Jules Guéron, again in view of the Geneva conference.[36] On May 31, 1958 a first meeting between Guéron, Cornelis J. Bakker, the director-general of CERN, and John B. Adams, director of the protosynchroton division of CERN, laid the following terms of reference for the agenda of the Joint Study Group:

> to note and evaluate plasma physics research programmes aimed at fusion at present being conducted or planned in Europe and in other countries; to consider and make suggestions for coordinated European fusion programmes; to consider and make suggestions of the means by which such programmes could be carried out either by existing national research centres or by the creation of a European centre; to consider and estimate other research programmes that could be undertaken by small centres and university departments; to consider and make suggestions for the training of suitable staff for the above programmes in universities and other centres.[37]

During the meeting it was agreed that members of the Group "should be European scientists engaged in fusion research work who could be considered as experts in this field and whose advice is particularly valuable to the study group's work". The Italian scientists invited were Bruno Brunelli and Enrico Persico. Euratom would contribute two thirds of the estimated expenses, and CERN one third. Euratom's contribution would however not exceed 75,000 Sw. Frs for 1958.[38]

Participation in the Joint Study Group was inserted in Euratom's first Research Program laid down on June 19, 1958, as complementary to the strengthening of fusion research in national centers: "cependant, le sujet est si neuf que l'on doit aider plusieurs équipes, même petites et modestement outillées, et qu'il convient d'encourager des recherches annexes. Il y a donc lieu de prévoir, avant même la fin de l'étude CERN-Eurat-

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36 Krige, "The First Twenty Years".

37 Euratom-CERN Joint Study for Fusion Research, *Minutes of Meeting held at CERN to discuss the possibility of setting up a joint study group to consider European fusion research programmes*, June 2, 1958, AAm, SADF, 190, 1, 1.

38 Euratom-CERN Joint Study for Fusion Research, *Minutes of Meeting*, June 2, 1958, AAm, SADF.

om, d'assez important contrats avec un ou deux centres puissants, et de plus nombreux contrats d'études auxiliaires".[39]

This line was confirmed by Euratom's Technical and Scientific Committee, chaired by Amaldi, during a meeting when Francis Perrin, member of the Committee and Haut Commissaire of the French CEA, "souligne l'importance de la fusion contrôlée et les espoirs qu'elle suscite, mais insiste sur les difficultés techniques et économiques auxquelles on se heurte aujourd'hui. Il estime qu'il y a là un objectif intéressant, quoique lointain, pour lequel Euratom pourrait être chef de file".[40]

The joint Euratom-CERN project would soon, however, meet the opposition of some members of CERN that were not members of Euratom. In addition to Great Britain, which at the time was the most advanced European country in nuclear fusion, tied to the United States by a series of nuclear special relationship agreements, the project met the opposition of Switzerland and Sweden, two neutral countries particularly sensitive to questions which might worry public opinion. Nuclear fusion could be related in the public mind to the H bomb and this raised also worries about the image of CERN, especially in that early start-up phase. CERN explicitly excluded any research which could bear any commercial or military return. Some members of CERN thus resented the project "as an unacceptable redefinition of CERN's identity".[41]

Finally, in June 1958 the CERN Council rejected the proposal of a joint CERN-Euratom study group. The failure of this initiative showed the difficulties in combining the efforts of two very different organizations with respect to membership, aims and structures.

At the same June 1958 meeting, the Council of CERN decided instead to set up its own Study Group to which representatives from European and other countries working in the field should be invited, and whose task would be to evaluate the research programs at present in progress or in preparation.[42]

In July 1958 Bakker informed Guéron that

> unfortunately, the objections to our joint proposal raised by some of our CERN Member States, who are not members of Euratom, were still maintained. The Council noted with appreciation the offer of Euratom to co-operate in an evaluation of plasma physics research programmes, but finally decided that, for the time being, CERN should conduct its own study. However, CERN proposes to invite

39 Euratom, la Commission, Division Recherche n° 95, *Programme de recherches*, Bruxelles, 19 juin 1958, AAm, SADF, 190, 1, 1.

40 Euratom, la Commission, Comité scientifique et technique, *Projet de compte-rendu de la réunion du 7 juillet 1958*, Bruxelles, 18 juillet 1958, AAm, SADF, 190, 1, 1.

41 Krige, "The First Twenty Years", 30.

42 European Organisation for Nuclear Research, *Annual Report 1958* (Geneva: CERN, 1959).

> Euratom and other organizations which might show an interest in the matter to send observers to the study group.[43]

The CERN Study Group held three meetings. In the letter of invitation to Persico to join the Group, Adams explained that the purpose of the first meeting was "to establish a list of the research programmes in the USA, USSR and Europe, the state of the work and the results obtained".[44] All European laboratories working in the field of fusion research, as well as CERN, Euratom and the OECE, were asked to send representatives.

The first meeting was held on September 25-26, 1958, shortly after the Atoms for Peace conference in Geneva. Nearly all the members of the Study Group had taken part themselves in the conference, and the meeting was devoted to "trying to assimilate the information released" at the conference.[45]

During the second meeting on December 11-12, 1958 various papers and reports were discussed, on specific research and experiments carried out in the members' laboratories, and a comparison was made with the work being undertaken in the United States and the Soviet Union. "The Study Group, having this time more or less assimilated the vast amount of published literature in the field of fusion research and having reviewed, in the light of this knowledge, their own fusion programmes" were able to begin to discuss the general problem of fusion work in Europe.

The aim of the third meeting, held on March 5 and 6, 1959, was to prepare a final report to be submitted to the CERN Council and to "define the nature of the work to be done in the near future". According to the report,

> the fundamental physics, on which all devices and projects depend, has proved to be much more intractable than was originally estimated. It is therefore clear that the major task before anyone in fusion work in the near future is to accelerate the understanding of the physics of plasma. However, such a conclusion does not imply that large scale experimental work should be abandoned, nor does it mean a slowing down of fusion activities. A properly balanced programme must allow for the study of fusion problems, theoretical, experimental and technological, on as broad a front as is economically possible …. A European fusion programme should aim at encouraging this diverse activity at all levels and by whatever means that are appropriate.

43 Letter by Cornelis J. Bakker, Director-General of CERN to Jules Guéron, July 3, 1958, AAm, SADF, 175, 2, 2.

44 Letter by John B. Adams to Enrico Persico, "CERN Study Group on Fusion Problems", July 31, 1958, Archivio Enrico Persico, Dipartimento di Fisica, Università "La Sapienza", Roma (hereafter AEP), 16/73.

45 An account of the three meetings is in the Final Report, see *European Fusion Research: Report of the CERN Study Group on Fusion Problems*, 2nd draft, March 24, 1959, AEP, 16/73, from where subsequent quotes are taken.

A comparison was then made between the European effort (the largest laboratories in Britain, France and Germany) and the US effort in terms of scientific staff (210 versus 288) and operating costs (6.7 million dollars versus 28.7). Although the number of staff was comparable, costs were "but a small fraction of those of the USA".

However, the report continued, "the staffing problem in fusion research is not fundamentally different from the problem of finding staff for the other branches of physics. There is undoubtedly a serious shortage of physicists in Europe, and plasma physics and fusion research can only take a fraction of these people". Education and training should be supported in European universities, and the "exchange of staff working on fusion problems between the various laboratories" encouraged. "Now that there are no longer any questions of security or classification in fusion work, the problem is only one of arranging that European staff can move freely between the laboratories", as it was "already an established tradition" in several laboratories and "an accepted way of life in high energy physics".

The study group also considered the possibility of establishing a "European" laboratory for fusion problems, not meant to replace the national laboratories, but "in addition to those already existing". The several pros and cons were weighed and it was concluded that for the time being, "unless it can be demonstrated that a European laboratory is needed in order to build larger facilities than can be built by national groups, the many other advantages of such a centre may prove insufficient to overcome the difficulties in its creation and maintenance". The matter was therefore left for a later review.

Euratom, however, was playing a new role in the European research scenario, and its relation to CERN needed to be assessed,

> The part being played by Euratom in the fusion work was discussed by the Study Group. Euratom represents six of the twelve member states of CERN and unfortunately does not contain the most currently active member state in the work of fusion, namely Britain. The policy of Euratom on fusion is to encourage the growth of large centres in its member states by placing contracts for fusion work. … Their general policy, therefore, is to concentrate the fusion work in order to counteract the dispersion tendency.

The system was similar to the American one. However, whereas in the United States the AEC formed "a backbone to the whole venture", in Europe this raised the question of supervising fusion activities, as there was "no such common organization although the large national centers can be compared with the AEC laboratories in the States".

The Report of the Study Group was presented at the thirteenth session of the CERN Council in May 1959. It recommended against the establishment of a common European fusion research laboratory, but proposed the continuation of a loose association for information and the exchange of ideas. The CERN Council approved this report and agreed that CERN for the time being should sponsor the Study Group until the end of the year, a period which was subsequently extended at the December session until the end of 1960.[46] The Group, under the continuous stimulus of Adams, would continue to hold scientific meetings until 1964 in several places and laboratories, widely attended by the European fusion community of the time.

The Euratom-CEA Association Contract

In September 1958, probably also as a consequence of the failure of the joint CERN-Euratom undertaking, the Euratom Commission put Palumbo in charge of the launching of a Community fusion program. Palumbo was well aware of the difficulties that a common fusion facility would raise (as it had been discussed on a more general European level during the CERN meetings), even if established in the new JRC in the process of being instituted. Rather, as anticipated also by Euratom's Scientific and Technical Committee, it was thought preferable to set up a network of contracts of association between Euratom and the national centers that were dealing with fusion research: the Community would coordinate and supervise the financial and scientific effort in the field. As Palumbo himself later recollected, "we should try to provoke collaboration within the six Member States, based on mutual confidence and co-responsibility", "In the course of this, I encountered some considerable difficulties and even hostility, not only from within the Commission but also from some of the potential partners. However, a Coherent European Fusion Programme was finally constituted".[47]

The new network of contracts of association would constitute the framework within which all fusion research in Europe would be developed, and would remain so for many years. The structure was partly modeled on that of the Sherwood Project, where the Sherwood Committee financed and coordinated research in American fusion laboratories.[48]

On December 23, 1959 the Commission met the representatives of the national nuclear authorities of the member states, with Palumbo and Guéron, in order to set the priorities of the new Community and outline the first five-year plan. During the meet-

46 European Organisation for Nuclear Research, *Annual Report 1959* (Geneva: CERN, 1960).
47 Palumbo, "The Work".
48 Bromberg, *Fusion*.

ing the importance of fusion was restated, and the first association contract on nuclear fusion signed with the French CEA was announced.[49]

The contract was located in Fontenay-aux-Roses (FAR) and was managed by a Comité de gestion (CdG), that met every three months and was made up of two representatives of Euratom (Palumbo and Ellerkmann, while Guéron attended the first meetings); two representatives of the CEA (Jacques Yvon, director of the Physique et Piles atomiques section of the CEA, and Jean-Pierre Goure), and Georges Vendryes, chief of the Département de Recherche Physique of the CEA, who was named chief of the Groupe de recherche of the association.[50] The chairman of the CdG was alternatively (on a yearly basis) either Palumbo or Yvon. The initial budget (350 million [old] francs) was 75 per cent at Euratom's expense and 25 per cent CEA. In 1959 there were 61 personnel involved in the contract (including 2 women); in 1961 the number had already increased to 150, one third of whom were Euratom employees.

Early activities were mainly devoted to an exchange of researchers with other laboratories, in particular in the United States and in the United Kingdom. Furthermore, in 1959, during the first negotiations for British entry in the Community, the United Kingdom-Euratom agreement was signed, which foresaw cooperation in nuclear fusion.[51] Fusion soon became an important part of the CEA activities at FAR, and very quickly developed to the extent that a complete reorganization was carried out in 1962, also involving a change in the terms of the contract with Euratom (participation became Euratom 54 per cent, CEA 46 per cent). The Service de phisique of the CEA Centre of Saclay was also included in the contract, with regard to studies on plasma behavior that could be related to controlled fusion.[52] In 1962 there were 127 personnel (including 6 women) – 84 from CEA and 43 from Euratom.

49 Commission Euratom, *Compte rendu sommaire de la réunion du 15 décembre 1959 à Val Duchesse*, AHCEA, HC, F5.17.11. Italy was represented by Ippolito, Forcella and Naschi of CNEN, France by Perrin, Goldschmidt and Yvon of the Cea; for Germany Wolfgang Filkelnburg and Dietmar Fuchs.

50 The Groupe de recherche included a Service de recherches sur la fusion, whose Chef de Service was Hubert and his alternate Prévot. Hubert would then become director at the Direction Recherche et Enseignement of Euratom. On this early French fusion community see Anatole Abragam, *De la physique avant toute chose* (Paris: Odile Jacob, 1987).

51 Mauro Elli, *Politica estera ed ingegneria nucleare. I rapporti del Regno Unito con l'Euratom (1957-1963)* (Milano: Unicopli Editore, 2007).

52 On fusion research carried out by the CEA in those early years see M. Trocheris, "Controlled Thermonuclear Fusion Research Conducted by the French Commissariat à l'energie atomique", in *Peaceful Uses of Atomic Energy*. Proceedings of the fourth international conference, United Nations-IAEA, Geneva, September 6-16, 1971, vol. 7; Trocheris, "The History and Future of the French Fusion Programme", *Plasma Physics and Controlled Fusion* 29 (1987): 1425-27.

The Laboratorio Gas Ionizzati and Early Italian Research on Nuclear Fusion

The launching of research on fusion in Italy can be dated back to May 1957 when Persico, professor in the Department of Physics of the University of Rome and one of Enrico Fermi's "ragazzi di via Panisperna", created a research group on ionized gasses bringing together some researchers (Bruno Brunelli, Franca Magistrelli, Alberto De Angelis) already active in research on sources of radio frequency ions at the Istituto di Fisica superiore. In June 1957, Persico and Amaldi[53] attended the international congress on ionized gasses in Venice, where they exchanged views and information on plasma and high temperature production. Immediately after the congress, and again in September 1957, Bruno Brunelli visited several laboratories abroad (namely, the Imperial College in London, Saclay, CERN, Amsterdam, the Clarendon Laboratory in Oxford, and Aachen),[54] while Persico and Amaldi were making contacts with eminent scientists in the field of fusion research. They organized exchanges and seminars in Rome, inviting, among others, Franco Rasetti, who was in the United States at Johns Hopkins University, and came to Rome in 1959 for a series of seminars on plasma spectroscopy; and George Linhart, from CERN, who gave a series of seminars on plasma physics, then edited by Franca Magistrelli and Ugo Ascoli. On September 20, 1957 Ippolito, Secretary General of CNRN, asked for a first draft budget and anticipated an amount of 10 million lire to provide the group with a more institutional framework.[55]

On October 18, 1957 the formal decree was signed that established the Laboratorio Gas Ionizzati (LGI), which consisted of a theoretical and an experimental group.[56]

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53 One the most distinguished Italian scientists, Edoardo Amaldi came from the group of "ragazzi di via Panisperna" led by Enrico Fermi. The main figure behind the reconstruction of postwar Italian physics, he was director of the Department of Physics in Rome, President from 1960 to 1965 of the Istituto Nazionale di Fisica Nucleare and member of the Board of CNRN, then CNEN. He served as chairman of Euratom's Scientific and Technical Committee and as secretary general of CERN from 1952 to 1955. On Amaldi, see Carlo Rubbia, *Edoardo Amaldi. Scientific Stateman* (Geneva: CERN, 1991), http://cds.cern.ch/record/228364/files/CERN-91-09.pdf, last accessed April 19, 2016; Fernando Ferroni, ed., *The Legacy of Edoardo Amaldi in Science and Society*, Atti del Convegno (Bologna: Società italiana di fisica, 2010); Lodovica Clavarino, *Scienza e politica nell'era nucleare. La scelta pacifista di Edoardo Amaldi* (Roma: Carocci, 2014).

54 Bruno Brunelli, *Relazione sulle visite ai laboratori stranieri di ricerca sui plasmi ad alta temperatura*, n.d., AEP, 15/72.

55 On this early phase see also Luisa Bonolis and Franca Magistrelli, "La nascita e gli sviluppi della ricerca sui plasma e sulla fusione nucleare in Italia", *Analysis* 3-4 (2010): 27-44; Bruno Brunelli, "The History and Future of the Italian Fusion Programme", *Plasma Physics and Controlled Fusion* 29 (1987): 1429-38, and on the general background of Italian research in physics at the time, Claudio Villi, *La fisica nucleare fondamentale in Italia* (Padova: Cleup, 1976).

56 CNRN, Laboratori Gas ionizzati, *Resoconti organizzativi e scientifici*, n.d. (but December 1957), AAm, SADF, 198, 1, 4. The group was composed of Persico and Amaldi as scientific supervisors, Brunelli, Magistrelli, Ascoli, De Angelis, Segre, and A. Bernardini (lab technician).

In January 1958 a preliminary five-year research plan was outlined, with an estimated budget of 550 million lire.[57]

In 1960 the LGI, under the direction of Brunelli, was moved to Frascati, where the Laboratori Nazionali had just been constructed in order to host the Electrosincrotron. In 1960 CNRN changed its name to Comitato Nazionale per l'Energia Nucleare (CNEN). Its active and dynamic Secretary-General Ippolito provided the necessary financial and "political" support for the LGI's early steps, as yet another tile in the framework of the Italian nuclear program, that was intended as a project of modernization of national scientific research and nuclear industrial application.[58] As Brunelli himself recalled, "fortunately, in those years we had Felice Ippolito, who very quickly met our demands".[59] The LGI was subsequently joined by John Allen, from Harwell, and George Linhart, Charles Maisonnier and Heinz Knopfel, from CERN.

The launching of the Italian fusion program was also embedded in the optimistic climate following the Geneva Conference of 1958, as seen above. A long Report by Felice Ippolito on the conclusions reached by the conference and on the Italian position is worth dwelling upon. Is also worth remembering that at the Geneva conference Italy presented a joint study with the World Bank – the Energia Nucleare Sud Italia (ENSI) Project – for the construction of a nuclear plant in Southern Italy, which would become the Garigliano nuclear power plant, and which put Italy in all the international media regarding nuclear developments.[60] The Italian participation, although limited, had given a qualified and "favorable impression", showing that Italy, "although a late-comer, intends to make up for lost time".[61] Although mainly devoted to the prospects of nuclear fission, the Conference had been dominated by the declassification of information on nuclear fusion:

> Noteworthy results have been reached in this field by the United States, England, and the USSR, and by some minor countries, like France. During the sessions the

57 CNRN, *Programma di ricerche sul plasma*, Com RF/04/58, January 1958, AAm, SADF, 198, 1, 4.

58 On the launching of the Italian nuclear project in the second half of the 1950s and the role of Felice Ippolito, see Barbara Curli, *Il progetto nucleare italiano, 1952-1964. Conversazioni con Felice Ippolito* (Soveria Mannelli: Rubbettino, 2000).

59 See the interviews with Bruno Brunelli and Sergio Segre in *Energia, ambiente, innovazione, dal Cnrn all'Enea*, ed. Giovanni Paoloni (Roma-Bari: Laterza, 1992), 246-47. In this same volume see also Claudio Cigognetti, "I laboratori nazionali di Frascati, 1957-1982", 209-18. On this early phase see also Fernando Amman and Romano Toschi, "I Laboratori Nazionali di Frascati del Comitato Nazionale Ricerche Nucleari", *Ingegneria nucleare* II, no. 4 (1959): 175-85.

60 On the Ensi Project see Barbara Curli, "Energia nucleare per il Mezzogiorno. L'Italia e la Banca Mondiale, 1955-1959", *Studi Storici* 37, no. 1 (1996): 317-51.

61 *Relazione preliminare sulla II Conferenza di Ginevra sugli usi pacifici dell'energia nucleare*, settembre 1958 (unsigned, but written from Geneva by Felice Ippolito), AAm, SADF, 160, 2, from where subsequent quotes are taken.

> programs that the major powers intended to pursue in this research field have been discussed, which was particularly useful for specialists in other countries in order to coordinate programs and avoid duplication and waste of manpower and means.

However, it was evident that "practical industrial applications [are] still very far ahead and even the first step, that is, to produce a controlled fusion in a laboratory, [is] far away". Great powers devoted "enormous means" to fusion, but "the most eminent scientists attending the Conference agreed that these studies are still at a 'university stage'". And this was probably the reason why the Russian delegates had been so "open" on the issue, but very tight on all other matters (nuclear plants, uranium and thorium supplies on Soviet territory, etc.).

The Association Contract CNEN-Euratom

The association contract between the LGI and Euratom (Contratto di ricerca Euratom-CNRN [then CNEN]-Laboratorio Gas Ionizzati) was signed in January 1960. It originated as a sub-contract of the CEA contract, until 1962, when the CEA withdrew and the Italian contract became independent. Documentation shows that the idea of associating the LGI to the French contract may have been first put forward by Brunelli, who in a letter to Persico wrote: "I have told Hubert and Palumbo about the sub-contract …. They suggested that we should advance a formal request, that will be read at the next Comité de gestion to be held in early September".[62] The issue was then followed up by Amaldi with Guéron in Brussels. Guéron guaranteed that Palumbo and Vendryes were taking care of it.[63]

The first meeting of the association was held in July 1960 in Rome at the Physics Department. The Comitato di gestione (CdG) of the Italian contract was constituted by Amaldi, President of the Istituto Nazionale di Fisica Nucleare, as representative of CNRN (that in August 1960 would become CNEN, where Amaldi was a member of the Board); Palumbo as representative of Euratom; and Brunelli, as chief of the Research Group. Until 1962 a representative of the CEA would take part in the meetings: it was alternatively Michel Trocheris, of the Service de Physique théorique and chief of the Controlled fusion Department at the CEA, and Vendryes.

Even after 1962, when the CEA withdrew from the association, either Trocheris or Vendryes continued to attend the meetings in Frascati, and Brunelli those at Fontenay-aux-Roses. At times Giovanni Naschi, director of the Segreteria tecnica of CNEN, and

62 Letter from Bruno Brunelli to Enrico Persico, August 24, 1959, AEP, 15/72.

63 Letter from Jules Guéron to Edoardo Amaldi, September 16, 1959, AEP, 7/20.

in charge of its financial management, was present at the meetings. In 1965 Amaldi left the CdG because of other obligations, and was substituted by Sebastiano Sciuti.[64]

The Guidelines (*Regolamento*) of the CdG were modeled on the French one. The financial effort of the Italian contract was distributed as follows: Euratom 60 per cent, CNEN 40 per cent, for a total amount of around 270 million lire for 1963.

The Group was made up of 57 people. The group's only woman, Franca Magistrelli, remembers those years as "the most intense and productive years of my professional life".[65] Brunelli recalls "the great enthusiasm" of that period.[66]

In this early phase, research in Frascati developed along two main directions: the so-called Program A (directed by John Allen, originally from Harwell, then in Frascati as Euratom's employee) on "Cariddi", the "Hot Ice" experiment, etc.; and Program B (directed by Linhart) on MIRAPI (MInimum RAdius PInch) and MAFIN (MAgnetic Field INtensification, whose implementation required the construction of the Colleferro bunker).

Great importance was attributed to training and education, as particularly endorsed by Amaldi, and to developing ties with the University of Rome and other Italian universities, e.g. through the creation of graduate fellowships. A new generation of fusion experts would develop through a continuous exchange with laboratories abroad, in Europe, the United States and the Soviet Union. New figures were created in the Euratom framework, such as the *stagiaire qualifié d'Euratom*, who was allowed to train in European laboratories. The CdG also dealt with the organization of meetings and conferences; decisions on papers to be submitted to international conferences, etc. By the mid 1960s, a European fusion community had been established, in particular thanks to Euratom's financial effort and Palumbo's coordinating role.

After the first two years of operation (the association contract was originally intended to last for two years and six months), a CNEN internal document made a first assessment of the status of research on fusion in Italy and of the relationship with Euratom. Euratom had appreciated the work carried out by LGI and had proposed not only the renewal of the association as from July 1, 1962, but also the strengthening of the program, for a total amount of 3 billion lire on a three year period, of which 40 per cent at the expense of CNEN.[67]

64 Reconstruction of the activity of the CdG is based on the Minutes of Meetings, in Archivi Enea Frascati, Contratto di ricerca Euratom-CNRN (Laboratorio Gas Ionizzati), poi Contratto di ricerca Euratom-CNEN (Laboratorio Gas Ionizzati), *Comitato di gestione, 1960-1968*.

65 On Franca Magistrellli, see "Franca Magistrelli", in *Maestri e allievi della fisica italiana nel Novecento*, ed. Luisa Bonolis (Pavia: Goliardica Pavese, 2008), 307-32, quote 318.

66 Brunelli, "The History", 1430.

67 CNEN, *Contratto di associazione CNEN-Euratom nel campo della fusione nucleare controllata*, GEN/24/62, ottobre 1962, AAm, SADF, 260.

Conclusion

The second phase of the association contract – that we are not dealing with here – would soon face a series of difficulties and shortcomings, related to the progressive bureaucratization of Euratom and its early "crisis", that would reflect itself in the drastic financial cut to the Community's second five-year plan, and to the crisis of the JRC at Ispra.[68] Cuts to the fusion program would be a direct consequence of these general changes (although they were less relevant than those affecting fission), before a wider reorientation of Euratom's activities took place as a consequence of the Merger of the executives in 1967. This would somehow affect all fusion programs in the various centers where association contracts were in operation – in addition to Fontenay-aux-Roses and Frascati, in the meantime Euratom had supported the launching of fusion programs in the German centers of Garching (the Max Planck Institut für Plasma Physik, where a contract had been signed with Euratom in 1961), and Jülich (in 1962); the Dutch centre of Fundamental Research on Matter (FOM, 1962) and the Belgian Ecole Royale Militaire in Brussels (1969).

Within this general framework, in the second half of the 1960s several difficulties would also affect national nuclear programs, including fusion programs, because of general economic and monetary troubles, the reconsideration of national fission programs (e.g. the French shift to light water reactors); and social and political unrest in 1968. In the Italian case, in particular, the crisis of the Frascati centre took place within the framework of the more general crisis of the Italian nuclear program, as a consequence of the "caso Ippolito" and the demise of CNEN;[69] and as a consequence of the events of 1968 and the resulting political and trade union unrest, which practically crippled activities in the Frascati Centre.[70]

This situation would soon require a re-launching of the European fusion program as a whole, which would only take place following the "tokamak revolution" announced at the Third Conference on Plasma Physics and Controlled Nuclear Fusion held at Novosibirsk in 1968, when Soviet scientists reported about the superiority of the toroidal configuration for magnetic confinement. A new phase of European fusion history would then be set into motion.

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68 On the crisis of Euratom and the difficult launching pf the second five-year plan, see Felice Ippolito, *Un progetto incompiuto. La ricerca comune europea, 1958-1988* (Bari: Dedalo, 1989).

69 On the "caso Ippolito", Curli, *Il progetto nucleare*; Curli, "Il caso Ippolito", in *Scienziati d'Italia. 150 anni di ricerca e innovazione*, ed. Marco Cattaneo (Torino: Codice Edizioni, 2011), 83-100.

70 On this critical passage at the Frascati Centre, see Giovanni Battimelli, ed., *L'Istituto Nazionale di Fisica Nucleare. Storia di una comunità di ricerca* (Roma: Laterza, 2002).

Mauro Elli

Italy in the European Fusion Programme during the 1980s: A Preliminary Overview

Even a cursory look at the existing literature on the European Fusion Programme (EFP) identifies two main recurrent themes: the creation of the Joint European Torus (JET) as a joint undertaking, and the related leading role of the long-lasting Director of the Fusion Programme in Brussels, Italian physicist Donato Palumbo.[1] The main thrust of these writings consists in tracing the success of JET back to early attempts at setting up a European program in controlled thermonuclear fusion by "networking" several scientific activities in national laboratories and universities, with a view to coalescing them into a coherent ensemble. This approach puts a premium on the hardly surprising political squabbles between member-states over the siting of JET, while it leaves comparably in the shadow the scientific "networking" as such, so that the latter is proposed somewhat as a mere precondition for the big device – the latter being intended both as a defining moment and the end of the story.

When it is investigated, this "pre-history" of JET is in no way juxtaposed – or, even less, opposed – to the joint undertaking; rather, it is often described as the successful outcome of a clever and unswerving work by a theoretical physicist turned science manager and "Eurocrat", i.e. Palumbo.[2] Most accounts prize his scientific authority and diplomatic skills, his vision for the future, and his pertinacity. In the same way, they recognize that the cornerstones of the EFP were a result of his own conceptions: networking via contracts of association and Euratom financial participation, the preferential support scheme in the 1971-1975 program, which pushed European laboratories to converge toward studies in toroidal plasma confinement; the special mobility scheme

1 Danis Willson, *A European Experiment: The Launching of the JET Project* (Bristol: Hilger, 1981); E. N. Shaw, *Europe's Experiment in Fusion: The JET Joint Undertaking* (Amsterdam: North Holland, 1990); Shaw, "Joint European Torus", *History of European Scientific and Technological Cooperation*, eds. John Krige and Luca Guzzetti (Luxembourg: Official Publications of the EC, 1997), 165-78.

2 Donato Palumbo, "Some Considerations on Closed Configurations of Magnetohydrostatic Equilibrium", *Il Nuovo Cimento* B 53 (1968): 507-11.

for scientific personnel; the creation of consultative committees to assure the overall coherence of European efforts and avoid redundancies.[3] In many respects, such accounts reflect Palumbo's own recollections of the Fusion Programme's history, as he made them public on a number of occasions.[4]

Such approach, which is comprehensively adopted even by a recent essay,[5] though it maintains a different focus and deals with a wider timespan, gives rise to two types of shortcomings: first, it has a leaning to look back to the past from the mid-1980s point of view, encompassing the following period in the realm of "consequences"; second, it focuses on Palumbo as a Commission senior official while leaving in the background the contribution of Italy to the Fusion Programme, and the role played by other Italian scientists and engineers in a number of capacities. This is still odder if one considers that in the 1980s Italy developed new sizable projects, which led her effort to be second only to the French and German ones under different headings.[6]

This chapter addresses the "presence" of Italy in the EFP during the 1980s focusing on the support for new Italian initiatives against the background of growing difficulties in raising the necessary funding for fusion in the context of the European Framework Program (FP).

The Background

By the end of the 1970s, with the creation of JET as a joint enterprise, and a growing orientation of the Programme toward fusion as a long-term energy source, the need was felt to adopt new structures for orientation, coordination, and control of activities.

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3 Umberto Finzi, "Palumbo Donato", in *Dizionario biografico degli italiani* 80 (2014), www.treccani.it, *ad vocem*; *Commemoration for the Life and Work of Donato Palumbo*, JET, November 21, 2011, Abingdon, United Kingdom; Harry Bruhns, "In Ricordo di Donato Palumbo (1921-2011)", *Il Nuovo Saggiatore*, http://static.sif.it/SIF/resources/public/files/ricordo/palumbo.pdf, last accessed February 18, 2016; Interview with Paolo Maria Fasella, July 31, 1998, Historical Archives of the European Union, European University Institute, San Domenico di Fiesole (Firenze), Italy (hereafter HAEU), INT585, 7.

4 Donato Palumbo, "The European Fusion Programme", in *Industry's Role in the Development of Fusion Power: Papers Delivered at the AIF Conference on Industry's Role in the Development of Fusion Power* (New York: AIF, 1981); Palumbo, "Nature and Prospects of the EURATOM Fusion Programme", *Philosophical Transactions of the Royal Society of London: Series A, Mathematical and Physical Sciences* 322 (1987): 199-211; Palumbo, "Setting JET on Track", presentation for the 25th Anniversary of JET, Culham, May 20, 2004; Palumbo, "The Work of the European Commission in Promoting Fusion Research in Europe", *Plasma Physics and Controlled Fusion* 29 (1987): 1465-73.

5 Patrick McCray, "'Globalization with hardware': ITER's Fusion of Technology, Policy, and Politics", *History and Technology* 26 (2010): 283-312.

6 Expenditures by the fusion associations in 1987, HUAE, ITER 9.

While JET would retain its own organization and each association would continue to be managed by a steering committee including representatives of the Commission, the overall overseeing structure of the Fusion Programme needed reform. After the Council's decision of December 26, 1980, the Consultative Committee on Fusion, the Liaison Group and the Committee of Directors were dissolved and replaced by a single Consultative Committee on the Fusion Programme (CCFP). The structure and guidelines of the CCFP were similar to the JET Council's, while its membership consisted of three representatives of the Commission, two members appointed by JET and for each member-state – as well as for the associate countries, i.e. Sweden and Switzerland – three representatives appointed by each national government. Every national delegation would include both a member coming from a State department and one from the scientific community. In the case of Italy, the three members were selected respectively by the Comitato nazionale per la ricerca e lo sviluppo dell'Energia Nucleare e delle Energie Alternative (ENEA), the Consiglio Nazionale delle Ricerche (CNR) and the Ministry for Scientific Research.[7]

The CCFP had the task of watching over ongoing activities, defining priority actions (subject to preferential support by the Community), and selectivity applying criteria in the definition of new activities. These criteria hinged on the "reactor relevance" of the proposed activity, namely ensuring a focus on tokamaks and a growing attention for the technological aspects of research and development compared to fundamental research in plasma physics. The tokamak (*toroidalnaya kamera magnitnaya katushka*, or "toroidal chamber and magnetic coil") is a magnetic confinement system originally developed in the Soviet Union, which, by the late 1960s, had become the frontrunner in fusion research by achieving a high plasma performance.[8] Central to this process of re-orientation was the definition of conceptual parameters for the Next European Torus (NET), ideally an engineering testing reactor linking JET to a future prototype reactor called DEMO.[9]

In the face of increasing expenses for devices and instrumentation, and to assure maximum continuity, it was agreed that after the first three years a new five-year research program would be implemented, overlapping the last two years of the previous one. This provision gave rise to an almost continuous process of scientific reappraisal and financial negotiation, which allows to sketch some basic features of the EFP during the 1980s. The decade opened with a very substantial budget of 750 millions European Currency Unit (MioECU) for the five-year program 1979-1983, leading to the launch of several mid-

7 "Communication from the Commission to the Council concerning the creation of a "Consultative Committee of the Fusion Programme", COM (79) 771 final, December 19, 1979 and CCFP first meeting, January 8, 1981, HUAE, ITER 1.

8 John Wesson, *Tokamaks* (Oxford: Clarendon, 2004), 15-23.

9 CCFP second meeting, March 9-10, 1981 and CCFP fourth meeting, April 7, 1981, HUAE, ITER 1.

sized experiments in support of or collateral to JET.[10] The entity of the effort was such that by 1982 it drove Palumbo to voice his concern and to propose a period of reflection.[11]

A measure of consolidation occurred already in the years 1982-1986,[12] but cuts were even heavier in the period 1985-1989, with the original proposition (790 MioECU) reduced by 100 MioECU. Though the allocation of funds for the years 1985-1986 allowed for the continuation of activities, a revision of the program became necessary for the post-1986 period. At this time Palumbo expressed his disappointment for the level of support the Commission's proposals had received from national governments once presented to the Council:[13] with fusion bound to be included in the FP – and oil prices heading to full-fledged counter-shock – the Fusion Programme was coming under careful scrutiny.[14]

The budget for the years 1987-1991 was caught up in the battle unleashed by the British determination to curb the projected second FP, which was eventually scaled down from 7.7 billions European Currency Unit (BioECU) to 5.4 BioECU.[15] This was a very delicate moment for the EFP, as the original budget estimate was increased by the preoccupation of strengthening NET and technology-related activities while international cooperation on the ITER project was taking shape. Though a measure of delay was unavoidable, fusion as a FP2 sub-action held out reasonably well, passing from an original request for 1005 MioECU to 985 MioECU, with the latter eventually being cut by 30 MioECU.[16]

The Presence of Italy

Against this background, Italy was able to reinforce its participation in the EFP by applying for preferential support (i.e. 45 per cent of funding from the Community) for two different projects, the Reverse Field Experiment (RFX) and the Frascati Tokamak

10 Note à la Commission, n.d., HAEU, ITER 1.

11 CCFP tenth meeting, June 22-23 1982, HAEU, ITER 2.

12 CCFP third meeting, April 7, 1981 and CCFP seventh meeting, October 15, 1981, HAEU, ITER 1; CCFP ninth meeting, April 2, 1982, HAEU, ITER 2.

13 CCFP twenty-first meeting, October 24, 1985 and Draft communication of the Commission to the Council on the Fusion Programme, n.d., HAEU, ITER 5.

14 "The scientific and technical strategy of the Community", COM (85) 140 final, April 9, 1985, HAEU, ITER 5.

15 Ingo Rollwagen, "Progress in Europe by Integrated Research Policy: Development and Challenges", *EU Monitor*, April 28, 2005: 16, http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000186906.pdf, last accessed February 18, 2016.

16 CCFP twenty-fifth meeting, February 6-7, 1986 and CCFP twenty-seventh meeting, June 19, 1986, HAEU, ITER 6; CCFP thirtieth meeting, April 29, 1987, HAEU, ITER 7; CCFP thirty-fifth meeting, October 26-27, 1988, HAEU, ITER 8.

Upgrade (FTU), respectively in March and June 1981.[17] Studies of the reverse field pinch family – basically a plasma column carrying current that produces magnetic forces that constrict the column, producing higher plasma densities, and in which the stabilizing toroidal magnetic field reverses on the outside of the torus – had been encouraged at Culham, Los Alamos and Padua by the intrinsically high Ohmic heating power of these devices and by the theoretical work of John Brian Taylor on the relaxation of plasma toward the natural state of lowest energy.[18] In explaining the experimental results obtained in the ZETA device at Culham, Taylor had produced a theory of the self-organization of the magnetic field where the plasma rapidly accesses to minimum-energy states (relaxation), which are the preferred state of the system, by controlling a few global parameters. This opened questions of how and why relaxation occurs.[19] Considering relaxation as a benign process, reverse field pinches were promising from a reactor point of view, since they offered a relatively high ratio of kinetic plasma pressure and magnetic field pressure (by and large an indicator of economic efficiency) and the expected possibility of reaching thermonuclear ignition without additional heating.[20]

In Padua, work on ionized gases started in the late 1950s on the initiative of the Institute of Electric Engineering directed by Giovanni Someda, with the support of the Institute of Physics under Antonio Rostagni.[21] In the 1970s research in toroidal devices and the pinch effect produced promising results in the context of an association between Euratom and the CNR, so that in 1979 the quiescent regime found on ZETA some twenty-five years earlier was reproduced for the first time. This gave rise to a new wave of research projects on the reverse field pinch; among them RFX, originally proposed by Culham as a 1 MA machine and then upgraded to 2 MA by the end of the 1970s, which had been envisaged as a tripartite venture in which Culham, Padua and Los Alamos would participate.[22]

In September 1981, cuts in the British fusion budget and the fact that JET was located at Culham led the United Kingdom Atomic Energy Authority (UKAEA) to

17 CCFP second meeting, March 9-10, 1981 and CCFP fifth meeting, June 26, 1981, HAEU, ITER 1.

18 John Brian Taylor, “Relaxation of Toroidal Plasma and Generation of Reverse Magnetic Fields”, *Physical Review Letters* 33 (1974): 1139-41.

19 Sergio Ortolani and Dalton Schnack, *Magnetohydrodynamics of Plasma Relaxation* (Singapore: World Scientific Publishing, 1993), 1-14.

20 Cornelius Marius Braams and Peter E. Stott, *Nuclear Fusion: Half a Century of Magnetic Confinement Fusion Research* (Bristol: Institute of Physics Publishing, 2002), 92-97.

21 For a brief review of early fusion research in Padua see Consorzio RFX, *Fisica e ingegneria della fusione: la ricerca verso una nuova fonte di energia* (Vigorovea: Graficamontaggi, 2007). On Someda and Antonio Rostagni, see Lorenzo Maranesi, *Giovanni Someda e il suo tempo* (Venezia: Ist. veneto di scienze, lettere e arti, 2004); Milla Baldo Ceolin, *Antonio Rostagni* (Padova: Società cooperativa tipografica, 1991).

22 Braams and Stott, *Nuclear Fusion*, 99-101.

inform the Commission that it was not in the position to keep RFX in its program. The American interest too failed to materialize. The Italian delegation to the CCFP, however, was able to express the willingness of the CNR to put in the money and build RFX in Padua. On April 2, 1982 physicist Piero Caldirola assured CNR funding to realize RFX, provided that the project received preferential support from the Commission as originally envisaged.[23]

In the meantime, the CCFP was discussing the proposal for preferential support for FTU put forward by the Laboratorio Gas Ionizzati (LGI) at Frascati. Back in the 1970s, in the wake of general interest by the scientific community for tokamaks, the LGI had established contacts with a group of physicists and engineers working at MIT. Among them, by the late 1960s, Bruno Coppi had developed the idea of producing high-temperature plasma with a compact tokamak with a small major radius, so that Ohmic heating per volume would increase and the temperature would rise. At MIT he had become acquainted with the Francis Bitter National Magnet Laboratory, a centre for the fabrication of exceptionally high field magnets, and its leading magnet designer, Bruce Montgomery. In addition to a small radius, now Coppi imagined a device with a formidable toroidal field called ALCATOR (i.e. high field torus), which by 1974 was achieving resounding success. As a consequence of contacts with MIT, the Frascati laboratory opted for a compact machine of small dimensions having a strong magnetic field, though tempered by the need of having plasma dimensions that were not so small as to disperse the power. This was the Frascati Tokamak, of which FTU was presented as an upgrade.[24]

FTU was criticized at the CCFP meeting of July 15, 1981. François Prévot, head of the CEA Fusion Department, expressed concern on the application of ALCATOR scaling laws (an empirical scaling criterion for calculating energy confinement time according to results in ALCATOR experiments) and, more generally, for a technology which combined high temperatures, high densities and high wall loading. Friedrich Wagner, who was working at Garching on the high-confinement regime for plasma,[25] questioned the NET relevance of FTU and its chance of reaching ignition without additional heating.[26]

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23 Arnold Allen to Donato Palumbo, September 15, 1981, HAEU, ITER 1; CCFP ninth meeting, April 2, 1982, HAEU, ITER 2.

24 Joan Bromberg, *Fusion: Science, Politics, and the Invention of a New Energy Source* (Cambridge: The MIT Press, 1982), 162-64, 230-31; Paola Batistoni, ed., *1960-2010: cinquant'anni di ricerca sulla fusione in Italia* (Roma: ENEA, 2010): 38-41, http://www.fusione.enea.it/EVENTS/eventifiles/50esimo/50anni-fusione.pdf, last accessed February 18, 2016; Kenneth Fawler, *The Fusion Quest* (Baltimore: John Hopkins University Press, 1997), 180.

25 Friedrich Wagner et al. "Regime of Improved Confinement and High Beta in Neutral-Beam-Heated Divertor Discharges of the ASDEX Tokamak", *Physical Review Letters* 49 (1982): 1408-12.

26 CCFP sixth meeting, July, 15, 1981, HAEU, ITER 1.

By the time the CCFP Programme Committee agreed in recommending preferential support for FTU, in January 1982 Palumbo announced that CNEN had sent a new proposal for preferential support in the form of a preliminary draft conceptual design for a high-field, compact tokamak called Ignited Torus (IGNITOR). Indeed, while ALCATOR represented a relatively inexpensive way to study tokamaks in a university environment, at the International School of Fusion Reactor Technology held at Erice, Sicily, in September 1976 Coppi had proposed developing a new line of compact devices as a parallel program to large tokamaks like JET to reach plasma ignition.[27]

The IGNITOR proposal, however, was not really welcomed by the CCFP, which refused to call in American experts to appraise it. After a long discussion, in June 1982 the CCFP requested a position from Etienne Davignon, then vice President of the Commission with responsibility for industrial, energy and research matters, who appointed a special panel chaired by famous British scientist John Adams to assess the scientific and technical interest of IGNITOR for fusion research, as well as the soundness of the project. On the same occasion, both the French and the Germans expressed a negative attitude toward the building of RFX at Padua – with the Germans insisting that RFX had to be seen in connection with IGNITOR.[28] This connection might have disruptive effects both at a European level and in Italy, where the fusion association was being reorganized so that ENEA would take over CNR fusion activities, notably RFX. The Adams Panel reported to Davignon on December 23, 1982, casting both lights and shadows. IGNITOR could be a complementary, low-cost experiment, but the apparatus was considered as potentially dangerous.[29]

Meanwhile, the CCFP agreed on preferential support for RFX by majority vote – not unanimously as would be expected after a positive technical appraisal (and, indeed, as was the case for the other 'alternative line', i.e. the German stellarator Wendelstein 7-AS).[30] European funding for RFX and, most likely, for FTU made the uneasy coexistence with IGNITOR a reason for perturbation in Italy. On the one hand, the two Italian associations with Euratom were being merged under ENEA, the latter being the statutory organization responsible for nuclear energy and other alternative sources, so that RFX (a CNR project) was to fall under the ENEA umbrella. On the other hand, the Ministry for Scientific Research (the parent department of the CNR) insisted on

27 Bruno Coppi, "Compact Experiments for α-Particle Heating", in *Tokamak Reactors for Breakeven: A Critical Study of the Near-Term Fusion Reactor Program*, ed. Heinz Knoepfel (Oxford: Pergamon, 1978), 303-26.

28 CCFP eight meeting, January 7-8, 1982 and CCFP tenth meeting, June 22-23, 1982, HAEU, ITER 2.

29 John Adams to Etienne Davignon, December 23, 1982, HAEU, ITER 3.

30 CCFP eleventh meeting October 20, 1982, HAEU, ITER 2.

the relevance of fusion research (and RFX, in particular) in connection with the Project "Energetics II" (Progetto Finalizzato Energetica II). The latter was a big research and development exercise organized by the CNR in the context of the Piano Nazionale di Ricerca per l'Energia; ENEA would take part on equal footing with its steering committee. On December 22, 1982, the Comitato Interministeriale per la Programmazione Economica (CIPE) approved the start of "Energetics II", but it recommended a comprehensive appraisal of Italian fusion activities in order to define national priorities for action in the field – with special attention to costs and possibilities of European cooperation such as RFX.[31]

Such an appraisal, in fact, was tantamount to holding in abeyance RFX for the time being. Rumors spread that the Italian Government would not support the project anymore. At the CCFP meeting of February 1983, Cees Braams, director of the Institute for Plasma Physics in Nieuwegein (FOM) and "founding father" of Dutch research on nuclear fusion, asked the Italian delegation to comment and Caldirola, hinting at the relationship between RFX and "Energetics II", stated that the position of the CNR had not changed. On the same occasion, FTU received preferential support status and Romano Toschi, the Italian representative from Frascati, definitely stated that IGNITOR did not feature in the fusion association program of ENEA.[32]

These facts seem to point to the possibility that it was IGNITOR, as a latecomer project without any immediate prospect of European funding, which sent shockwaves through the Italian party and put into question the future of RFX. The hypothesis is reinforced by the fact that ENEA was apparently unwilling to put forward a formal proposal regarding IGNITOR, a precondition for any further action by the CCFP. Indeed, this was particularly surprising at a moment when IGNITOR and a tritium handling laboratory figured as favorite items to fill the large gap left at the JRC by the cancellation of Super-SARA – a light-water reactor safety research project abandoned amid chronic delays, escalating costs, and allegations that Italian entities had got too large a share of research contracts.[33]

By June 1983, the Italian authorities confirmed the validity of RFX, but they refrained from giving the green light to the project still pending a decision on funding. At the CCFP meeting of June 15-16, Giorgio Rostagni (Antonio's son and disciple of Giovanni Someda), who had taken over from Caldirola in view of the sensitivity of the RFX situation, tried to reassure his colleagues by pointing out that the delay was due to changes in the Italian government, but the project had passed all stages of verifica-

31 CIPE, delibera n. 107, December 22, 1982; *Progetto finalizzato energetica 2. Studio di fattibilità* (Roma: CNR, 1982).

32 CCFP thirteenth meeting, February 9-10, 1983, HAEU, ITER 3.

33 CCFP fourteenth meeting, April 19, 1983, HAEU, ITER 3.

tion except for the final decision. Undeterred, the CCFP passed a resolution that was actually an ultimatum: if Italy did not make up its mind by the meeting scheduled for October 19-20, 1983, then the CCFP would conclude that RFX did not have the support of the Italian association.[34]

After the general election and the formation of the first Craxi government in August 1983, just a few days before the CCFP deadline the Ministry of Industry and the Ministry for Scientific Research proposed including RFX in the program of ENEA. On October 19, CIPE authorized the necessary funds, but it also recommended that ENEA start a feasibility study of IGNITOR drawing on the existing documentation.[35] The following day, Rostagni was able to take part in the second day of the CCFP meeting after the news had been communicated from Rome directly to commissioner Davignon. On that occasion, the CCFP further noted the merging of the ENEA and CNR contracts and that the financing of RFX would be assured under the single ENEA contract of association.[36]

Subsequently, the troubled life of RFX went relatively smoothly. Even though the collaboration with American and Japanese laboratories, as originally envisaged, did not materialize, the project succeeded in covering a 7.5 MioECU gap through European funds, notwithstanding the constraints to Fusion Programme budgets in the mid 1980s.[37] The RFX construction phase was substantially completed by 1991 and the experimental phase began in 1992.[38] Nowadays the Consorzio RFX is the site where the prototype of one of the plasma heating systems for ITER is being built in cooperation with India and Japan.[39]

FTU started operating in 1989, with a reduced toroidal field compared to the earlier Frascati tokamak (from 10T to 8T), in order to allow openings in the vacuum chamber necessary for the installation of all the radio frequency power coupling structures foreseen. Indeed, unlike IGNITOR (in which Ohmic heating was expected to play a major role), the new high field tokamak at Frascati was developed as a test-bed to study plasma heating and non-inductive current drive[40] efficiency in high density plasmas by equip-

34 CCFP fifteenth meeting, June 15-16, 1983, HAEU, ITER 3.

35 CIPE, delibera n. 93, October 19, 1983.

36 CCFP seventeenth meeting, October 19-20, 1983, HAEU, ITER 3.

37 CCFP twenty-eighth meeting, October 29-30, 1986, HAEU, ITER 6.

38 Giorgio Rostagni, "RFX: An Expected Step in RFP Research", *Fusion Engineering and Design* 25 (1995): 301-13.

39 Sabina Griffith, "Signature Seals Future of Neutral Beam Test Facility", *ITER Newsline*, November 5, 2010.

40 On the interest in maintaining a tokamak current indefinitely by a combination of the electric current self-generated inside the plasma and various mechanisms for non-inductive external current drive, see Braams and Stott, *Nuclear Fusion*, 187.

ping it with three different radio frequency heating systems.[41] Some difficulties occurred in mid-1985 through a combination of budget cuts to the Fusion Programme in general and raising estimates for the installation of a lower hybrid device, i.e. one of the three most successful schemes for radio frequency heating.[42] As Roberto Andreani (director of the ENEA fusion division at Frascati) explained, earlier Italian estimates had been approximate, notably because the potential supplier of gyrotrons had not been able to quote a firm price. Now asked for a revision of the financial ceiling agreed for the heating scheme, the CCFP agreed by majority vote with the provision that ENEA verified the practicability of the heating method via a pre-experiment in the Frascati Tokamak with electromagnetic power at the highest end of the frequency range.[43] One should not make too much of these dynamics, however, as it was in the logic of the CCFP to criticize actions proposed for preferential support in order to assure both the overall coherence of the Fusion Programme and a spend-wise approach to research. Accordingly, in October 1988, the CCFP awarded preferential support both to an ion Bernstein wave experiment,[44] i.e. the use of a hot plasma wave to carry the radio frequency power to heat the tokamak reactor core, and to high density Electron Cyclotron Resonance Heating tests[45] on FTU, provided that ENEA could demonstrate the availability of a gyrotron of advanced design in a time consistent with the proposed timescale pursuant to the technical suggestions received.[46]

As far as IGNITOR was concerned, in 1984 Coppi made a direct approach to Davignon, and on July 12 a special meeting recognized the substantial changes introduced in the original proposal, so that it was agreed that the CCFP would reconsider the project. In October 1984, the Committee questioned Coppi extensively, in particular on the possible position of IGNITOR in the European strategy and whether it was aimed at more than attaining ignited plasma. Coppi admitted that not too much attention had been given to burn stabilization and that, once the physics of the machine had been proven, another core should be built for material testing. At the end, the CCFP, though recognizing the importance of experimental studies of burning plasmas, did not formulate an opinion, nor took any further steps. IGNITOR should be seen in connection with the present US interest in physics machines for the study of burning plasmas, the CCFP concluded, so that it might be played as a possible way of strengthening international collaboration.[47]

41 Batistoni, *1960-2010*, 72-82.

42 Wesson, *Tokamaks*, 261-62, 286-90.

43 CCFP twenty-second meeting, May 23-24, 1985, HAEU, ITER 5.

44 See Braams and Stott, *Nuclear Fusion*, 187.

45 See Wesson, *Tokamaks*, 290-99.

46 CCFP thirty-fifth meeting, October 26-27, 1988, HAEU, ITER 8.

47 CCFP twentieth meeting, October 17-18, 1984, HAEU, ITER 4.

Indeed, Coppi's idea inspired Princeton, with strong backing from the director of the Magnetic Confinement Program in the US Department of Energy, to propose the Compact Ignition Tokamak (CIT) specifically to study the physics of burning plasmas. CIT soon captured the enthusiasm of American fusion scientists, concentrated on advancing toward ignition, even though few if any regarded CIT design as a direct path to a reactor. But CIT's physical dimensions grew dramatically – reflecting the difficulty of building a high-field tokamak with engineering structures that left enough space for a plasma – and the project was abandoned in 1990 among fears that it would not ignite.[48]

On October 15, 1986, the Italian Minister for Scientific Research, Luigi Granelli, directly addressed the vice President of the European Commission, Karl-Heinz Narjes, proposing the inclusion of IGNITOR in the much-discussed program for 1987-1991. After stressing the American interest in this kind of device, Granelli re-launched the idea of siting IGNITOR at Ispra – this time as a joint undertaking. Under this condition, the Italian government would be ready to assume a substantial financial commitment to the project. A couple of weeks later, the Commission – with the support of the Italian delegation – proposed putting the IGNITOR design phase within the activities of the Euratom-ENEA association, thereby granting a support in the order of 2-4 MioECU, which would be included in the financial ceiling of the contract of association for the period 1987-1991. Meanwhile, it would be possible to explore bilaterally with Italy ways and means for the construction of IGNITOR. However, the CCFP's reaction was very cold. Expressing their concern at launching such an initiative before reaching a possible understanding with the United States, some delegations questioned the compatibility of the project with the ongoing construction of RFX and FTU by ENEA. On a more general note, the CCFP pointed out the difficulty of including IGNITOR in the Community strategy, as it was based on big tokamaks with a growing focus on technology and engineering.[49]

The matter, however, remained quiescent for more than two years. The Italian delegation presented the official proposal for priority support only in February 1989. The CCFP reacted once again by voicing the usual misgivings: what would IGNITOR bring to the European Programme? Would it really ignite and what contribution would a transiently ignited device give to the study of burning plasmas? Francis Troyon, director of the Plasma Physics Research Center at the École Polytechnique Fédérale of Lausanne and discoverer of a relationship that expresses the limit in pressure that cannot be

48 Braams and Stott, *Nuclear Fusion*, 228; Fawler, *The Fusion Quest*, 181.

49 Luigi Granelli to Karl-Heinz Narjes, October 15, 1986, and CCFP twenty-eight meeting, October 29-30, 1986, HAEU, ITER 6.

exceeded in a plasma,[50] raised a number of technical points concerning the interconnectedness of physics and technical solutions for such a compact device like IGNITOR. He pointed out the damaging psychological consequences that could arise if, after all, IGNITOR did not ignite. Robert Aymar, then head of the CEA fusion department, requested that IGNITOR's position be considered in direct relation to the US intention of proceeding with CIT – by then on the eve of being cancelled. The CCFT concluded that the proposal should be examined in depth and as diligently as possible,[51] but IGNITOR would never receive Euratom support.

Conclusion

Even from this very restricted investigation, the relevance of Italy to the EFP is considerable, both quantitatively and qualitatively. Italy was able to take advantage of the substantial fusion budget of the early 1980s and successfully defended its major projects, not so much in a logic of "just return", but by conceiving and deeply connecting them to the mainstream of the fusion community. One notable exception is IGNITOR, which has long since remained a subject of heated controversy in the scientific community and, of course, politically.

More research is needed on the political aspects, focusing on the feedback/relationship between scientists and science managers on the one hand and government/EC officials on the other. Far from representing a mere context, this link might be a way to test the consistency of Italy's European policy, maybe discovering a realm in which the country could be ambitious without any risk of marginality.[52] There is a preliminary proviso, however: is this matter really relevant for the understanding of contemporary Italian history? If one cursorily examines references on the country's history in the 1980s, the provisional answer would be negative.[53]

50 François Troyon et al., "MHD-Limits to Plasma Confinement", paper presented to the XI European Conference on Controlled Fusion and Plasma Physisc, Aachan, September 1983, ed. December 1983, http://infoscience.epfl.ch/record/120771/files/lrp_231_83_hq.pdf, last accessed February 18, 2016.

51 CCFP thirty-sixth meeting, February 2-3, 1989, HAEU, ITER 9.

52 See Marinella Neri Gualdesi, "L'Italia e l'Europa negli anni ottanta: tra ambizione e marginalità", in *L'Italia nella costruzione europea. Un bilancio storico (1957-2007)*, ed. Pietro Craveri and Antonio Versori (Milano: FrancoAngeli, 2009), 79-108.

53 See, for example, Silvio Pons, Adriano Roccucci and Federico Romero, *L'Italia contemporanea dagli anni Ottanta a oggi*, 3 vols. (Roma: Carocci, 2014); Marco Gervasoni, *Storia d'Italia degli anni Ottanta: quando eravamo moderni* (Venezia: Marsilio, 2010); Antonio Varsori, *La cenerentola d'Europa? L'Italia e l'integrazione europea dal 1947 a oggi* (Soveria Mannelli: Rubbettino, 2010); Simona Colarizi, ed., *Gli anni Ottanta come storia* (Soveria Mannelli: Rubbettino, 2004); Ennio Di Nolfo, ed., *La politica estera italiana negli anni Ottanta* (Manduria: Lacaita, 2003).

While it is understandable that historical analysis have focused on traditional political and diplomatic dynamics and, as one scholar noted, the attention to the role of scientists in Italian society has been intermittent,[54] this relative lack of attention is somewhat strange. Be it an effect of the traditional Italian difficulty in considering natural sciences as part of "culture"[55] or a manifestation of conflicting views on the possible role of scientific research in Italy,[56] historians should reflect on the relevancy of a subject like fusion research, not simply as an exercise in international or transnational history, but as a significant contribution to the understanding of contemporary Italy and her relations with the rest of the world.

54 Giuliana Gemelli, "Gli scienziati", in *Le élites nella storia dell'Italia unita*, ed. Guido Melis (Napoli: Cuen, 2003), 213-39.

55 Antonio Ruberti, "Riflessioni sul sistema della ricerca dopo il 1945", in *Ricerca e istituzioni scientifiche in Italia,* ed. Raffaella Simili (Roma: Laterza, 1998), 213-30.

56 Giovanni Paoloni, "Lo sviluppo scientifico italiano nell'ultimo sessantennio: due modelli a confronto", *Meridiana* 54 (2005): 39-61.

G. B. Zorzoli

Did the Italian Decision Makers Understand that Nuclear Is Not Business as Usual?

In the last sixty years, viewpoints on nuclear energy have been evolving from a broad feeling of confidence in its valuable contribution to the generation of cheap energy, increasingly independent of fossil fuels, toward growing skepticism or even open opposition. This was a multi-factor process, and a careful analysis would require a dedicated paper. Therefore, the following pages touch only on a few elements, in my opinion the most relevant ones.

What I have called "technological hubris" provoked an undue acceleration of nuclear development. Shippingport, the first American nuclear power plant, was a 60 MW pressurized water reactor (PWR). It was modelled on the submarine Nautilus nuclear propellant and, without any significant change, started operating in 1957. It was followed by the 205 MW Yankee plant and the 210 MW Dresden 1 plant, both in operation by 1960, which increased the initial capacity by 3.5 times. The escalation continued with the building of the San Onofre 1 (460 MW, 1967), the Haddam Neck (600 MW, 1968), and the Zion 1 and 2 (1000 MW each, 1973) plants. In just sixteen years, their capacity increased by almost twenty times.[1]

Given that construction times were very long, companies had to start building their power plants before acquiring the necessary information from their forerunners, sometimes even before their start-up. The usual learning by error process was missed and larger size power reactors were built before obtaining and assessing the operational results from the previous smaller size plants. This led to design and manufacturing errors, which turned into malfunctions and cost increases.[2]

The paradoxical effect was a penetration rate much higher than usual in global electricity production. Historical energy transitions have been slow, spanning several dec-

1 G. B. Zorzoli, *Il sistema elettrico e le nuove sfide tecnologiche* (Roma: Editori Riuniti, 1997), 64.

2 G. B. Zorzoli, *I due volti del mercato elettrico. Storia, tecnologie e liberalizzazione del settore elettrico in Italia* (Milano: Cappelli Identity Design, 2012), 160-61.

ades.[3] Between 1970 and 1985, the nuclear growth rate was higher than 16 per cent per year, more than three times compared to oil during its first decades. Meanwhile, costs and malfunctions increased, instead of going down, as expected because of the combined impact of scale effect and learning by doing.

This decreased public confidence in nuclear technology, also because the issue of the ultimate disposal for long-term radioactive waste has not yet been solved.

When accidents happened (which technological hubris had categorically ruled out), doubts on the actual safety of nuclear power plants increased. Efforts to design safer reactors led to today's evolutionary power reactors (EPRs), which are producing electric power at a price twice as high as that of the electricity market.[4] Thus, the nuclear power share of world electricity generation, after reaching around 17 per cent at the end of the last century, decreased to 10.7 per cent in 2014.[5]

If today's nuclear perspectives are meager, in the past some industrialized countries succeeded in installing a remarkable set of nuclear power plants. The oddity of the Italian approach to nuclear energy is its failure to achieve any comparable result, even when nobody opposed such a policy.

The following sections will analyze the reasons for that failure.

The Basis of an Effective Nuclear Policy

After the 1973 oil crisis, France did not develop the most effective nuclear pattern by mere chance. Decision-makers were aware that installing nuclear power plants requires a complex organizational structure, where several players – both enterprises and public bodies – are allowed to interact inside well-designated boundaries.

Unlike conventional power plants, which are authorized only on the basis of an Environmental Impact Assessment and are fired by fossil fuels (coal, oil, natural gas), nuclear power plants:

1) are made up of many more and more sophisticated components and subsystems, which implies the parallel set-up of highly qualified suppliers;
2) must be linked to a nuclear fuel manufacturer;
3) have to deal with a Nuclear Safety Authority, which can require both a prelimi-

3 Roger Fouquet, "The Slow Search for Solutions: Lessons from Historical Energy Transitions by Sector and Service", *Energy Policy* 38 (2010): 6586-96.

4 UK Government, "Initial Agreement Reached on New Nuclear Power Station at Hinkley", press release, October 21, 2013.

5 World Nuclear Association, *Nuclear Power in the World Today*, www.world-nuclear.org/information-library, updated January 2016, last accessed May 11, 2016.

nary Safety Report (if accepted, the nuclear power plant can be built) and a final Safety Report (to authorize the plant operation); the same Authority can impose design or component changes during construction, and is entitled to control the plants throughout their operational lifetime;

4) are charged with the problems related to the plant decommissioning and radioactive waste disposal.

An interactive structure implies a roughly equipollent effectiveness from all the actors involved, since other players cannot cover big differences, as they have different skills and duties.[6] Moreover, when the size of a country places limits on its resources, the huge investments required in developing a supply chain technology force decision-makers to choose a single technology. As a result, the most effective means to achieve these goals is through central planning, carried out by an authoritative government, which can select (or set up) appropriate players and impose its policy. This was the French way to nuclear.

The US nuclear program was the opposite of the successful French one. In spite of the huge know-how that was accumulated from the very beginning of the nuclear age, and the amount of public money poured into the development of civilian reactors, on the private side the organizational structure remained too loose and scattered among too many utilities. Their size was often insufficient to operate a nuclear power plant, leading to accidents such as the one in Three Mile Island.[7]

Indeed, the free market does not fit nuclear policy requirements well, even less so when decision-makers' behavior recalls the chaotic Brownian motion.

The Italian Nuclear Takeoff

In Italy, political and entrepreneurial engagement in the nuclear business began in the mid-1950s, i.e. ten years later than in countries such as France and the United Kingdom. It was to last less than ten years, from the first Conference on the Peaceful Uses of Atomic Energy (held in Geneva in August 1955) to December 1962, when the act to nationalize the electricity system was approved.

That engagement was tied to two concurrent factors: first, to the debate about the proposal to nationalize the electricity system, which was in its initial phases; second, to

6 Sergio Vaccà and G. B. Zorzoli, "E' ancora possibile una cultura nucleare in Italia?", Workshop *L'energia nucleare in Europa, un problema aperto*, IEFE, Università Bocconi, July 14, 2003, paper published in *Economia delle fonti di energia e dell'ambiente* 46, no.1-2 (2003): 85-90.

7 *Report of the President's Commission on the Accident at Three Mile Island*, Washington, October 30, 1979.

the belief, which spread in Italy after the Geneva Conference, that nuclear energy would become so cheap as to achieve a dominant share in electricity generation.

All the main players in the Italian energy field tried to control the nuclear option: while public enterprises (public utilities and the state-owned company Ente Nazionale Idrocarburi, ENI) became the institutional body in charge of implementing nationalization, private utilities aimed at stopping any move toward this option.[8]

At first, the struggle revolved around the attempt to control the Centro Informazioni Studi ed Esperienze (CISE), a nuclear research and development center set up by private enterprises shortly after World War II.[9] An agreement signed in 1955 led to a fifty-fifty share between private enterprises and the Istituto per la Ricostruzione Industriale (IRI) and ENI, whereby CISE was assigned the task to build a nuclear research center in Ispra on behalf of a new public body, the Comitato Nazionale per le Ricerche Nucleari (CNRN).

Two years later, in October 1957, the agreement came to an end. More than one third of CISE's scientists were hired by the CNRN and a few months later ENI left CISE to set up a new company, the Azienda Generale Italiana Petroli (AGIP) Nucleare. Two of CISE's shareholders, the car manufacturer Fiat and Montecatini, then Italy's leading chemical company, set up the nuclear research and development company Sorin. Suddenly, research and development resources, which had been concentrated around CISE, became fragmented, making it more unlikely to achieve a critical mass.

The CISE case was the first sign of a clash between different and incompatible strategies. On one side, there were people like ENI's President Enrico Mattei and CNRN's Secretary General Felice Ippolito, who had a vision of what Italy's future should be, consistent with contemporary needs. On the opposite side, there was the old-fashioned culture of people managing private utilities, always opposed to any change to the status quo. Between them, there were the top managers of public utility companies, grouped inside IRI, whose positions were close to those of their colleagues working for private firms.

Even the traditional partnership between private and public utilities did not survive this clash. In 1957, IRI opted out of the Società Elettronucleare Italiana (SELNI), a joint company created in 1956 to enter the nuclear business, and set up its own firm, the Società Elettronucleare Nazionale (SENN), which received support from the CNRN.

Between 1956 and 1958, three nuclear projects were launched. SELNI, controlled by Edison, was assigned the task of building a first generation PWR power plant in the town of Trino Vercellese, in Piedmont. The American company Westinghouse was Edi-

8 G. B. Zorzoli, *Il sistema elettrico e le nuove sfide tecnologiche* (Roma: Editori Riuniti, 1997), 24-26.

9 Sergio Zaninelli, ed., *Ricerca, innovazione, impresa. Storia del CISE: 1946-1996* (Roma-Bari: Laterza, 1996).

son's traditional supplier, via Franco Tosi and Ercole Marelli, who were Westinghouse licensees. SENN, on the other hand, which was owned by the IRI group, built a first generation boiling water reactor (BWR) power plant in Southern Italy, near Garigliano. In this case, the license owner was General Electric, whose Italian licensee was the firm Ansaldo, IRI's main supplier. Following these decisions, ENI's newly founded nuclear company Società Italiana Meridionale per l'Energia Atomica (SIMEA) built its own nuclear power plant, near Latina, using the only other technology available at the time, the British Magnox type nuclear reactor (natural uranium fueled, graphite moderated, gas cooled).

Italian firms used three different technologies, which were chosen for reasons unrelated to their inherent qualities, and did not follow any long-term strategy. The Italian government and lawmakers remained spectators or passive supporters of decisions that were taken elsewhere, making Italy an odd case study.

The Long Sleep

Three events led to the end of this struggle around nuclear power. In 1962, Mattei was killed. In 1963, a judiciary plot excluded Ippolito from the nuclear game, with the aim of challenging his project of a long-term nuclear policy for Italy.[10] Between December 1962 and the Spring of 1963, in order to comply with the electricity system nationalization act, all electric utilities, with the exception of those owned by local municipalities, merged into the newly-created Ente Nazionale per l'Energia Elettrica (ENEL).

Once the three nuclear power plants were completed in the early 1960s, no additional nuclear capacity became operational until 1981. This long sleep depended neither on social opposition, which started only in the late 1970s, nor on economic concerns, since nuclear energy was still considered to be convenient.

A major turning point was Ippolito's detention and his subsequent revocation from ENEL's Board of Directors, which decided to get rid of the only person opposing the policies carried out by the company's chief operating officer, Arnaldo Maria Angelini. Between 1963 and 1978, first as ENEL's CEO, then as its President, Angelini decided to match Italy's increasing electricity demand through heavy oil fired power plants, thus complying with the interests of oil companies.

In the same period, Italy became Western Europe's oil refinery platform. To keep investment costs down, private and public companies involved in the oil business opted for processing plants that operated as simple distillers (as cracking remained quite lim-

10 Orazio Barrese, *Un complotto nucleare. Il caso Ippolito* (Roma: Newton Compton, 1981).

ited). Thus, the average composition of the oil processed in Italy was such as to produce 50-55 per cent heavy oil as output, a product with a limited market, which was definitely much lower than its yearly output.

The problem was solved selling heavy oil to ENEL, at a price low enough to make nuclear energy too expensive. An act that allowed the use of heavy oil with up to a 3 per cent sulphur content, along with the replacement of stack emission limits with land fall-down limits, which were respected by making stacks higher than usual, addressed the issue of the oil's high content of polluting agents (above all sulphur).

As a result of these changes, Italy's nuclear share of electricity generation decreased from a world record of 4.2 per cent in 1965 to a meager 1.2 per cent in 1980 (Table 1), while the thermal generation share (78 per cent heavy oil fired) increased from 40.8 per cent to 71.8 per cent.

Year	Hydro	Geothermal	Thermal	Nuclear	Total
1965	43,008	2,576	33,874	3,510	82,968
1980	47,511	2,672	133,350	2,208	185,741

Table 1. Electricity production by source (GWh). Source: TERNA, *Dati statistici sull'energia elettrica in Italia, dati storici*, 2013.

In the meantime, Angelini became one of the main public supporters of nuclear power. His lectures, conference papers and public statements, always forecasting a medium-long term development of nuclear power (his favorite data was a 50 per cent nuclear share in the long term), would fill a library.

ENEL also continued to support nuclear projects, provided that they remain outside the commercial realm, which was increasingly made up of light water reactors (LWR). The most noteworthy projects, because of their cost and lifetime, were the following:

1) The CISE Reattore a Nebbia (CIRENE), a heavy water moderated, two-phase water-cooled reactor, developed by CISE. Its 40 MW prototype was built by ENEL, but after twenty years it was not yet in operation and was stopped by the 1987 referendum;
2) Participation in the Superphénix project, a 1200 MW fast breeder reactor (FBR), whose design began in 1968, was connected to the grid in December 1994 and was closed in September 1998.

When it was conceived in 1957, CIRENE looked very promising. However, soon after the decision to build its prototype was taken, both Canada and the United Kingdom gave up similar projects. Only Canada used heavy water technology, while other countries chose LWRs. The fast breeder technology remains a question mark, and forty years ago it was definitely a risky gamble.[11]

In order to hush up political lobbying in favor of Ansaldo, in 1969 ENEL commissioned an 860 MW BWR plant, to be built near Caorso, in the Emilia-Romagna region. Its construction was lengthy and cumbersome, despite the active support granted by local authorities.[12] It was connected to the grid in December 1981 and produced electricity until 1986. A twin unit, which should have been installed on the same site, was never commissioned.

The Response to the Oil Crisis

In the 1950s, too many people around the world considered nuclear power like manna from heaven. Therefore, Italian decision-makers should not be blamed, even if they did not understand that nuclear was not business as usual. A decade later, following the idea that ENEL would provide the tools to manage Italy's electricity policy, the Italian government allowed the company to become a proxy, supporting it even in decisions that implied risks for the country's security.

Given that sooner or later you can be sure your sins will find you, with the increase of oil price following the 1973 oil crisis, it became clear that the policy ENEL was following had very frail bases.

Forty years ago, nuclear technology was still the most promising alternative to fossil fuel electricity generation. The oil crisis revamped interest in renewable sources. However, in the early 1970s photovoltaics had limited applications, and only in the space sector, while the few existing wind energy installations were old fashioned. Therefore, the immediate response was to go nuclear.

In the 1970s, it was quite clear that nuclear was not a usual business,[13] and that it required a system approach, i.e. a step by step build-up, which was the expression of a considered thought instead of something hurriedly thrown together.[14] On the contrary, ENEL proposed an unrealistic program: to build 20,000 MW in ten years, split between ten power plants, each made up of two twin 1000 MW units. In September 1975, the project was included in the Piano Energetico Nazionale (PEN), which did not provide

11 G. B. Zorzoli, *Il dilemma energetico. Per un nuovo medioevo tecnocratico o un nuovo umanesimo socialista?* (Milano: Feltrinelli, 1975), 136-37.

12 G. B. Zorzoli, ed., *Piacenza capitale dell'energia. Una storia lunga diversi secoli* (Piacenza: Tip. Le. Co. Piacenza, 2008), part IV.

13 Oliviero Bernardini, "L'energia nucleare tra errori di previsioni e necessità reali", *Economia delle fonti di energia* 40 (1990): 37.

14 Gianni Cozzi, Sergio Garriba, Giorgio Giorgetti, Renzo Tasselli, Sergio Vaccà, G. B. Zorzoli, *Lo sviluppo nucleare in Italia. Economia delle fonti di energia* (Milano: Franco Angeli, 1975).

any information about technologies or the plant siting, and omitted to indicate how responsibility should be shared among the operators.

Italy joined the European initiative to build a huge uranium enrichment unit at Pierrelatte, in France, and pre-purchased the enriched uranium required to fuel the planned nuclear power plants. Since these were never built, the enriched uranium was later sold at a loss.

Decision-makers knew the right pattern they had to follow in order to carry out a consistent and cost-effective nuclear program. However, they decided to ignore it so they would not displease anybody: a decision that was consistent with the way of acting preferred by Italian governments (business as usual in an unusual business).

ENEL supported the idea that competition between different technologies was the best economic solution. This argument worked in international auctions, but not in Italy, since all the power plants had to be built by Italian firms. Multiplying technological options prevented the achievement of cost benefits coming from scale effects and learning by doing. If a single technology had been chosen, ENEL would have been compelled to purchase that technology, but the company (like ENI) behaved as an independent body. It was inclined to refuse any external interference, due to the government's weakness, which had to a great extent lost control over public companies.

Moreover, the legacy of the events of the 1950s was still alive. Fiat had become a Westinghouse PWR licensee and acted as the head of the main component suppliers (the firms Tosi and Marelli). Ansaldo was not only a General Electric BWR licensee, but after manufacturing the CIRENE prototype, it had acquired the Canadian license for the commercial heavy water reactor (HWR). An additional complication came from the Belleli group decision to become the licensee of another PWR technology, developed by the American Company Combustion Engineering.

The only actual decision was taken in 1976, when ENEL commissioned Ansaldo to build a BWR nuclear power plant, made up of two 982 MW units, near the town of Montalto di Castro, north of Rome. It was not an easy task:

1) both Ansaldo and ENEL had no previous experience building a plant of that size;
2) the site was technically well-suited, but it was surrounded by archaeological remains;
3) for the first time, a strong opposition to nuclear power emerged locally, and became stronger as a result of mistakes made by Ansaldo and ENEL, which were unprepared to deal with social movements.

When the 1987 referendum put an end to the Italian nuclear program, only 70-75 per cent of the plant had been completed.

The multi-technology option became so unbearable that in the early 1980s PWR was selected as the national technology and Ansaldo was charged with deploying it. In theory, this was the best choice, since PWR was the winning technology. This decision, however, did not take into account that both Ansaldo and ENEL had gained manufacturing and operational experience only in the BWR technology, in Caorso, and were engaged in building the last BWR generation power plant at Montalto di Castro. Therefore, the previous learning by doing was mostly wasted.

Shortly thereafter the ENEL Board of Directors decided to change the previous industrial program: the future power mix had to be a balanced share of nuclear and new coal fired units, plus some of the operating oil fired plants converted to coal. The potential scale effect and learning by doing was therefore halved and the undisclosed, but clear cause of the new strategy – coal fired plants were easier to build – weakened nuclear perspectives even more.

When, after the Chernobyl disaster, the anti-nuclear movement collected the signatures needed to call a national referendum, politicians were so eager to remove what had become an embarrassing issue that Parliament passed an ad hoc act, allowing the referendum to be held even during an election year, in 1987.

Since there was no specific nuclear energy act to be repealed, the majority of people voted to cancel the incentives given to local municipalities for the building of new power plants and to revoke the authorization given to ENEL to join foreign ventures, which had allowed it to participate in the Superphénix project. Italians' opposition to nuclear energy was clearly expressed by the referendum results. Willing to get rid of the whole nuclear issue, the vast majority of the Italian Parliament not only decided to stop building new nuclear plants, as expected, but went further, and shut down the operating units as well.

I can personally attest that the vast majority of ENEL employees sighed with relief.

Bad Things Come in Threes

Despite its death sentence, the Italian nuclear business behaved like a karstic river, which goes underground, but keeps on flowing.

A joint venture between Ansaldo and the Consorzio Interuniversitario per la Ricerca Tecnologica Nucleare (CIRTEN), a consortium among university departments engaged in nuclear research and development, joined an international project aimed at developing the International Reactor Innovative and Secure (IRIS), a small size (about 300 MW) nuclear reactor, with a passive safety system.[15] Moreover, Ansaldo concurred in the construction of two HWR units, built by Atomic Energy of Canada Ltd. (AECL)

15 Mario D. Carelli et al., "The Design and Safety Features of the Iris Reactor", *Nuclear Engineering and Design*, 230 (2008): 151-67.

at Cernavoda, in Romania, and joined Westinghouse-Toshiba in developing an AP1000 PWR reactor, and in constructing Chinese power plants based on this technology.[16]

The karstic river resurfaced in 2008, when the Italian government decided to revamp the nuclear option. Despite its inherent inconsistency – Italy was clearly running toward today's overcapacity and it was already evident that third generation reactors were overpriced – like in the early 1980s, the decision was not based on the existing Ansaldo know-how (AP1000). Rather, it was political interests that led to the signing of an agreement with the French government, followed by a Memorandum of Understanding between Energie de France (EDF) and ENEL, aimed at promoting the building of four 1600 MW nuclear units, based on the French EPR technology, which was substantially different from the AP1000 one.

To keep Ansaldo quiet and open room for a potential second nuclear venture unwisely put forth by A2A, the theory of the advantage granted by competition among several technologies was revamped. In the end, Ansaldo signed an industrial partnership agreement with Areva, the French EPR manufacturer.

This time, though, the farce did not last long. In 2011, the nuclear accident that took place in Fukushima led, once again, to a referendum, the result of which was explicitly against any nuclear power program.

It was a conclusion to be expected, even before the last trial of launching nuclear power in Italy. As I wrote a couple of years before the Italian nuclear revival, "people regretting the Italian happy nuclear season in the 1950s must be conscious that the happy season then lived by the persons who were genuine supporters of the nuclear choice was not sustained by a strategy widely shared by the Italian ruling class. It was a choice instrumental to different goals. In the absence of such awareness, the risk of repeating past errors and illusions is very high".[17]

Errors were repeated and illusions were again raised, but their cost (either material or immaterial) was luckily kept low.

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16 Roberto Adinolfi, "Le strozzature da rimuovere", in *L'opzione nucleare in Italia: quali prospettive?*, ed. Associazione italiana economisti dell'energia (Siena: Lorenzo Barbera Editore, 2008), 114-15.

17 G. B. Zorzoli, "Dalla Conferenza di Ginevra alla prima crisi petrolifera: gli anni decisivi per la formazione del sistema nucleare italiano", paper presented at the conference *L'uso pacifico dell'energia nucleare da Ginevra 1955 ad oggi: il caso italiano*, Rome, March 8-9, 2006.

Conclusion

Besides its historical interest, understanding why nuclear failed in Italy is of the utmost importance to avoid similar errors today. For instance, the energy efficiency targets set by two European Directives[18] can only be achieved by using a system approach.

In particular, buildings must in perspective turn to Quasi Zero Energy Buildings, which will be the basic cells of smart districts and, to a larger extent, of smart cities.

Such a target, which is a "must" to mitigate climate change, requires joint and integrated actions involving many public bodies, research and development and private companies: this is exactly what was lacking in the case of the Italian nuclear policy.

The same stands in the case of policies promoting renewables: in Italy their unplanned penetration was more costly than needed.

18 EU, Directive 2010/31/EU of the European Parliament and of the Council on the Energy Performance of Buildings, May 19, 2010; EU, Directive 2012/27/EU of the European Parliament and of the Council on the Energy Efficiency, October 25, 2012.

Part II - Military Aspects of Nuclear Power

Massimiliano Moretti

A Never-Ending Story: The Italian Contribution to FIG

On November 28, 1957, the Defense Ministers of France, Italy and Germany (FIG) signed a far-reaching secret protocol which contemplated the possibility of atomic military cooperation. This episode has been studied, above all, by Georges-Henri Soutou and Leopoldo Nuti.[1] By building on their works, and with the aid of new sources, this chapter investigates Italy's involvement in this ambitious trilateral project. At the same time, this analysis sets forth certain information not strictly pertaining to the nuclear dimension of the endeavor. This narrative attempts to show that the established historiography may have over-estimated the atomic component of this story, by overlooking substantial forms of conventional military cooperation. Surprisingly, these attempts at conventional cooperation also reveal other hidden nuclear angles of this strangely polyhedral triangle.

Origins of the Project

Since 1954, proposals for establishing a European atomic force, centered around Franco-German scientific and financial cooperation, were advanced by certain high-ranking French military officers, like Army General Clément Blanc.[2] In this early phase of European nuclear dialogue, no role whatsoever was attributed to Italy. However,

1 While both scholars have written extensively on the topic, their most significant publications are, respectively, Georges-Henri Soutou, *L'alliance incertaine. Les rapports politico-stratégiques franco-allemands, 1954-1996* (Paris: Fayard, 1996) and Leopoldo Nuti, *La sfida nucleare. La politica estera italiana e le armi atomiche, 1945-1991* (Bologna: il Mulino, 2007). An important contribution on Italy's position in FIG is Paolo Cacace, *L'atomica europea. I progetti della guerra fredda, il ruolo dell'Italia, le domande del futuro* (Roma: Fazi, 2004).

2 Pierre Guillen, "La France et la négociation du traité d'Euratom", in *L'énergie nucléaire en Europe. Des origines à Euratom*, ed. Michel Dumoulin, Pierre Guillen, and Maurice Vaïsse (Bruxelles: Peter Lang, 1994), 111-29, see 111.

in December 1954, advisers to Pierre Mendès-France confided to Ambassador Pietro Quaroni that "France, Germany and Italy" would form the core of Paris' proposal for creating a European Armaments Pool, which might be restricted to "three sectors: atomic, electronic, aviation". Quaroni was told brutally that Italy, notwithstanding her limitations, had to be included because a purely Franco-German dialogue was inconceivable. Nonetheless, Mendès must have valued Italy's potential contribution, since he wished to bring Enrico Fermi back to Europe. It remains to be established when this desire was expressed, since the Italian Ambassador put pen to paper only after the Italian physicist had already passed away.[3] In the following months, Quaroni devoted himself to trying to interpret the grand design behind this plan: apparently, the French Prime Minister's lodestar was to create an "embryonic [European] Third Force" by reviving the European Defence Community (EDC) through a "Franco-Italo-German agreement"; by uniting their efforts, the Three could be equipped with "the essential weapons of today: atomic and thermonuclear, the electronic part strictly connected to them [and] aircrafts or missiles to deploy the A- or H-bombs". Quaroni condemned this project as "terribly illusory", since it would be unfeasible for at least another twenty years. Nonetheless, the Italian Ambassador believed that some results could perhaps be obtained by pooling together "the resources and the brains of the three countries".[4]

During the Euratom negotiations, Quaroni continued to be involved in backchannel conversations, which revealed the frustration of certain European policymakers. In fact, secret and parallel military discussions might have helped to accept the ambiguously pacifist nature of Euratom.[5] In November 1956, France finally agreed on the Euratom-Common Market package deal after the Suez crisis publicly displayed her weakness. However, almost simultaneously, the desire of Paris to be tied to Bonn was privately set down in a memorandum, which called for the creation of a bilateral Technical Committee in charge of military research and development. Chancellor Konrad Adenauer had only one doubt about this document: "what are we going to do for Italy?".[6] Franco-German military cooperation took off with the signing of the Colomb-Béchar and Baden-Baden protocols, respectively on January 17 and June 6, 1957. Both agreements

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3 Letter from Pietro Quaroni to Enrico Martino, Ris. 1654, December 10, 1954, Archivio Storico Diplomatico del Ministero degli Affari Esteri, Roma (hereafter ASMAE), Ambasciata di Parigi (hereafter APA), 1955, busta (box, hereafter b.) 55, 1° sottofascicolo (sub-folder, hereafter sf.) Pool degli Armamenti.

4 Letter from Quaroni to Martino, 0023, January 6, 1955, ASMAE, APA, 1955, b. 55, 1° sf. Pool degli Armamenti; Letter from Quaroni to Giuseppe Mancinelli, ris. 0242, February 12, 1955, ASMAE, APA, 1955, b. 47, fascicolo (folder, hereafter f.) R 4/7, Forze armate italiane.

5 Grégoire Mallard, *Fallout: Nuclear Diplomacy in an Age of Global Fracture* (Chicago: University of Chicago Press, 2014), 135.

6 Gunnar Skogmar, *The United States and the Nuclear Dimension of European Integration* (Houndmills, Basingstoke, Hampshire-New York: Palgrave Macmillan, 2004), 210-11.

obliquely implied possible forms of nuclear military cooperation.[7] In the meantime, German officials informed Italian diplomats that the French government was "especially" interested in carrying out "research in the field of nuclear weapons". Since the Bonn government appeared anxious to see other nations participate,[8] everything was in place for the unfolding of a more complex endeavor; Italy was not going to be left behind.

A Brief History

The Sputnik shock drew the final straw: in mid-November 1957, a closed Cabinet meeting of the Félix Gaillard government envisaged that, if the United States and the United Kingdom continued to discriminate against their partners, France would consider producing nuclear weapons with the financial and scientific aid of Germany and Italy.[9] A few days later, Franz Josef Strauss and Jacques Chaban-Delmas reached a comprehensive agreement. Its purpose was to generate close cooperation for the joint production of aircrafts and missiles, and to establish a common approach in the field of nuclear research.[10] At last, on November 28, in Rome, the three Defense Ministers signed a secret protocol which incorporated these ideas.[11]

Since the inception of the project, discussing the nuclear aspect of the FIG agreement with the United States represented a sore point for the Italian government. For example, on December 6, only at Secretary of State John Foster Dulles' insistence did Italian Foreign Minister Giuseppe Pella confess, almost hat in hand, that the trilateral conversations on "modern weapons" had revolved around both missiles and atomic warheads. In response, the Secretary of State requested that there be no surprises in the Atlantic Council meeting in Paris.[12] Tellingly, Gaillard's speech on December 18 did not denounce the unacceptability of the low-ranking position in which the FIG countries had been relegated.[13]

Just as things seemed to be settling down, on January 14, 1958, Italian Defense Minister Paolo Emilio Taviani rocked the boat by making a revelation which appeared

7 Soutou, *L'alliance*, 75-77; Nassima Bougherara, *Les rapports franco-allemands à l'épreuve de la question algérienne, 1955-1963* (Bern: Peter Lang, 2006), 42.

8 Unknown, Telespr. 47/0020, February 13, 1957, ASMAE, APA, b. 76, f. R-11/19, Patto di Bruxelles-UEO-Pool armamenti.

9 Soutou, *L'alliance*, 83.

10 Christian Pineau, Ministre des Affaires Étrangères aux Ambassadeurs de France à Bonn et Rome, 20 Novembre 57, *Documents Diplomatiques Françaises*, sous la direction du Maurice Vaïsse (Paris: Imprimerie Nationale, 1991) (hereafter DDF), 1957, tome II, document (hereafter d.) 359, 717.

11 Protocole, 25 Novembre 1957, DDF, 1957, tome II, d. 380, 762-63.

12 Manlio Brosio, *Diari di Washington, 1955-1961* (Bologna: il Mulino, 2008), 302-04.

13 Nuti, *La sfida*, 139.

both puzzlingly candid and artificially calculated.[14] He declared to representatives of the American Embassy in Rome that, "following preliminary discussions by the chiefs of staff of the three countries", the FIG group meant to "engage in joint production and procurement [of] modern arms including missiles, jet aircraft and nuclear energy", in order to each have a "small stockpile [of] atomic warheads" by 1963.[15] This common urge apparently had its foundations in a feeling of unreliability toward the American security guarantee.[16] Washington wisely chose not to make a *démarche* which could have been counterproductive for its nonproliferation policy: the State Department deemed that an attempt to prevent the three countries from engaging in nuclear weapons production might unintentionally make them move forward along this path.[17]

When the three Defense Ministers met in Bonn on January 21 they agreed to temporarily interrupt the nuclear facet of the trilateral agreement.[18] However, during that important meeting, they also decided to set up the works of a Tripartite Military Committee, a topic historians have almost entirely overlooked. It remains to be ascertained whether this organ included a civilian Scientific Research Commission, that was "responsible for research and development [of] nuclear weapons",[19] or tasked with studying atomic propulsion only.[20] In order to avoid misunderstandings, in March, the high-level Steering Committee agreed not to discuss the issue with North Atlantic Treaty Organization (NATO) or Western European Union representatives.[21] This could prove that, in comparison with politicians and diplomats, military officers were, in general, less prone to mislead officials from other countries as to the actual implications of what, at the time, was likely to be very modest and primitive nuclear research.

14 Nuti, *La sfida*, 143-45.

15 Despatch 878 from William P. Rogers to John Foster Dulles, January 17, 1958, National Archives and Records Administration (hereafter NARA), Washington, DC, Freedom of Information Act (hereafter FOIA), 740.56/1-1758.

16 (Sanitized) Tel. 2280 from James David Zellerbach to Dulles, January 16, 1958, NARA, Record Group (hereafter RG) 59, Central Decimal Files (hereafter CDF) 1955-59, box 3622, 765.5611/1-1658.

17 Tel. 2846 from the Department of State to Embassies in Rome and Paris, January 18, 1958, NARA, CDF, 1955-59, box 3622, 765.5611/1-1658.

18 Nuti, *La sfida*, 148-50.

19 Tel. 2276 from David Bruce to Dulles, January 25, 1958, NARA, CDF, 1955-59, box 3622, 765.5611/1-2558.

20 Umberto Grazzi to Rome, Telespr. 2136/483, February 15, 1958, ASMAE, Direzione Generale Affari Politici (hereafter DGAP), Ufficio I, 1945-60, vers. I, b. 171, f. NATO, Germania, 1958, Sf. Accordo bilaterale italo-inglese per la produzione di armamenti.

21 Compte rendu de la réunion du Comité Directeur qui a eu lieu à Paris les 27 et 28 mars 1958, Archivio Centrale dello Stato, Roma, Italy, (hereafter ACS), Ministero della Difesa-Aeronautica (hereafter MDA), Ufficio del Segretario Generale (hereafter USG), 1961, b. 3, f. 0.8.1/2 Allegati.

On April 8, however, the prospects for nuclear weapons production made a theoretical leap forward with the signing of yet another trilateral protocol.[22] By agreeing to co-finance a French isotope separation plant, the Defense Ministers reaffirmed their will to pursue nuclear military cooperation.[23] Even in late May, the French reassured the Italians and the Germans that the recently formed Pierre Pflimlin government intended to apply the November 1957 protocol in its entirety.[24] However, by the end of the month, the imminence of Charles de Gaulle's return to power started affecting the FIG project.

The "Grand" Finale

On June 17, 1958, a French restricted council meeting chaired by de Gaulle decided to suspend the trilateral nuclear cooperation, because atomic weapons should never be shared with others.[25] This apparently unquestionable explanation to the ending of the nuclear dimension of the FIG venture casts more than a shadow of a doubt. One must wonder why Chaban-Delmas, who was a Gaullist, had supported the project in the first place. Furthermore, de Gaulle, upon his return to power, had personally assured Quaroni that he was in favor of a "European atomic bomb".[26] The French General cunningly revealed to the Italian Ambassador that *he* had been the mastermind behind the project all along.[27] More importantly, the mystery of the British "strange account" of Italian Prime Minister Amintore Fanfani's meeting with de Gaulle remains to be solved. This particular version of the story is based on what Adenauer's private secretary referred to a British diplomat. According to this one document, found by Nuti in the Archives of the Foreign Office, Fanfani told Adenauer that the General had stressed the importance of cooperating in the field of military research, and even mentioned the possibility of developing a European atomic bomb. Nevertheless, Fanfani and Adenauer agreed that this option should be explored with extreme caution.[28] Although this convoluted dynamic may have led to a Chinese whispers effect, it is now possible to ascertain that Fanfani and de Gaulle did in fact speak of nuclear issues on August 7. The Italian Prime Minister

22 Paolo Emilio Taviani, *Politica a memoria d'uomo* (Bologna: il Mulino, 2002), 215.

23 Nuti, *La sfida*, 162.

24 Grazzi to Rome, Tel. 12059/183, May 21, 1958, ASMAE, Telegrammi Segreti, NATO, Parigi, 1958, in arrivo.

25 Colette Barbier, "Les négociations franco-germano-italiennes en vue de l'établissement d'une coopération militaire nucléaire aux cours des années 1956-1958", *Revue d'histoire diplomatique* 104 (1990): 81-113, see 112-13.

26 Taviani, *Politica*, 216.

27 Franz-Josef Strauss, *Mémoires* (Paris: Criterion, 1991), 411.

28 Nuti, *La sfida*, 167.

vaguely wrote in his diary that he brought peace between de Gaulle and Adenauer by starting their planned conversation on the atom.[29] No particular military significance can be deduced. Indeed, even if de Gaulle did explicitly mention the possibility of a European nuclear bomb, he may have simply been toying with Fanfani.

Meanwhile, talks on the final protocol signed by the Defense Ministers on April 8 continued. At the end of July, the French Commissariat à l'énergie atomique et aux énergies alternatives (CEA) invited representatives of the German Ministry of Defense to discuss technical and financial details of the French program for uranium enrichment.[30] A month later, the Italian General Defense Staff was still wondering whether or not to submit its evaluation of a June meeting to the Council of Ministers. On that occasion, representatives of the Italian Comitato Nazionale per le Ricerche Nucleari (CNRN) agreed to finance a yearly sum of about 10 billion lire to the French isotope separation plant. In exchange, the Rome government would be provided with "60 kilograms of uranium enriched at 95 per cent".[31] Whether it was due to a feeling of unrest toward de Gaulle's authoritative figure[32] or to a lack of resources,[33] Italy temporarily withdrew from this cooperative project. In light of this decision, the Fanfani government might be considered an accomplice in terminating the FIG nuclear effort.[34] Finally, the last mention of the Tripartite Scientific Research Commission is dated December 1958, when the three nations probably decided to put an ent to its existence.[35] While it is very likely that the French General had a say in this matter, there is no basis for arguing that this agreement was not commonly reached by all three parties.

In short, although de Gaulle undeniably played an important role in torpedoing whatever plan may or may not have existed for the creation of a European atomic deterrent, it would be a mistake to consider him as the only person responsible for undermining the nuclear side of FIG. Other actors were involved and many issues were at stake. Counterfactual reasoning, with the aid of historical documents, can prove to be a useful tool to assess the true effects of de Gaulle's actions. Wondering what could have happened *if* de Gaulle had not opposed the nuclear project can help make interesting conjectures. First of all, American technological superiority was a limiting factor on the

29 Amintore Fanfani, *Diari: 1956–1959*, vol. III (Soveria Mannelli: Rubbettino, 2011), 389.

30 Soutou, *L'alliance*, 138.

31 Nuti, *La sfida*, 163.

32 Achille Albonetti, "Storia segreta della bomba italiana ed europea", *Limes* 2 (1998): 157-71, see 159.

33 Barbara Curli, *Il progetto nucleare italiano (1952-1964). Conversazioni con Felice Ippolito* (Soveria Mannelli: Rubbettino, 2000), 194.

34 Nuti, *La sfida*, 166.

35 Foglio 627/CMT, December 10, 1958, Archivio dell'Ufficio Storico dello Stato Maggiore dell'Esercito (hereafter AUSSME), Diario Storico di Stato Maggiore della Difesa, Roma, Italia (hereafter DSSMD), III Reparto, b. 26.

German will to accomplish military standardization on the continent. This was revealed to be a "big problem" for the French since mid January 1958.[36] It would indeed have been "illogical",[37] if not impossible, to carry a French nuclear weapon on an American plane. Tellingly, the Germans opted for the Starfighter after the Americans insinuated that this aircraft would, in due course, receive a nuclear upgrade.[38] Finally, hypothetically extensive American technical and financial aid would not have induced Moscow to just stand idly by, quite the contrary.[39] Undermining the rules of peaceful coexistence by supporting this project would simply have been out of the question for Washington.[40]

These structural elements would appear to prove that de Gaulle could not have and did not singlehandedly decide the nuclear fate of FIG, one way or the other. By following this train of thought, it seems plausible to conclude, with a metaphor, that de Gaulle at best inflicted a final blow to a very sick or maybe incurable atomic body.

What Ever Happened to FIG?

According to a widespread scholarly interpretation, after de Gaulle interrupted the atomic talks, the FIG story was history. Soutou, instead, stresses that there was more to the FIG affair than just its nuclear aspects. He also points out that, in the early 1960s, trilateral cooperation on conventional weapons was continuing quite well, but not enough to satisfy the great non-nuclear ambitions which France had had since the very beginning.[41] However, it was Bertrand Robineau's work which, for the first time, defined the full life span of the Tripartite Military Committee: some trilateral Commissions continued to function until 1973, before Italy's withdrawal the following year.[42] Thanks to uncataloged sources from the Italian Central State Archive,[43] an unprecedented analysis of the activities of the Air and Rockets and Missiles Commissions in the early 1960s

36 Tel. 2207 from Bruce to Dulles, January 19, 1958, NARA, RG 59, CDF 1955-59, box 3622, 765.5611/1-1858.

37 Strauss, *Mémoires*, 413.

38 Hubert Zimmermann, *Money and Security: Troops, Monetary Policy, and West Germany's Relations with the United States and Britain, 1950-1971* (Cambridge: Cambridge University Press, 2004), 61.

39 Despatch 1498 from Max Isenbergh to Dulles, February 28, 1958, NARA, RG 59, CDF 1955-59, box 3165, 740.56/2-2858.

40 Ennio Di Nolfo, *Storia delle relazioni internazionali. Dal 1918 ai nostri giorni* (Roma-Bari: Laterza, 2009), 1014.

41 Soutou, *L'alliance*, 121, 140, 143.

42 Bertrand Robineau, *L'Histoire de l'armement terrestre*, tome 5, *Relations Internationales* (Paris: Centre des hautes études de l'armement, 2003), 99.

43 I owe an enormous debt of gratitude to Margherita Martelli, the director of the ACS, for helping me dig up these sources.

has disclosed unexpected trilateral nuclear details, although in the context of broader conventional military discussions.

At the meetings of the Air Commission held on May 11, 1960 in Rome, the Missiles working group was not able to draft a common "fiche-program" for air-to-surface missiles. Consequently, the technical specifications required by each delegation were listed in an annex. Curiously, four out of seven of these unidentified types of missiles were designed to carry a nuclear warhead: Italy and France were interested that a certain model would enter into service "as soon as possible", while France and Germany planned for two other kinds of these missiles to be available between 1963 and 1964. However, the most revealing piece of information included in this chart may be that the only characteristics on which the representatives of all three countries could agree were those of a single conventional missile.[44]

Another theoretical possibility for trilateral nuclear cooperation arose at the end of 1960. The French and German Defense Ministers agreed in late November to jointly study and develop a fighter with a primary strike role. This would supposedly have become the only standardized aircraft of the two countries' Air Forces. An examination commission was to select one out of two prototypes which would seem more appropriate for the military requirements of both countries. If the projects were to proceed in parallel, the two nations had to actively cooperate in selecting identical and interchangeable weapon accessories. The French "candidate" was the nuclear capable VTOL Mirage III.V. This proposal was submitted in mid-December to the Air Commission of the Tripartite Military Committee during which Italy was asked to participate.[45] No significant follow-up of this potential nuclear aspect of the FIG adventure has been found. However, it must be noted that this preliminary aeronautical Franco-German agreement was much more relevant and nuclear sensitive than the one reached in 1958, in which Bonn was only supposed to purchase a Mirage.

Finally, Germany and Italy became involved in discussions concerning the study and development of the French air-to-surface AS-30 missile and of its nuclear version, the AS-33. When the Italian Defense Minister, Giulio Andreotti, met his French counterpart, Pierre Messmer, in Paris on October 12 and 13, 1961, the latter proposed to co-produce missiles like the AS-30, along with other European countries such as Germany. Andreotti replied that Italy had been promised a better deal by the United States for the Bullpup missile.[46] However, in January 1962, the Italian Air Force still had not reached

44 Enrico Cigerza to Rome, Prot. n° 1247/CMT, May 23, 1960. ACS, MDA, USG, 1960, b. 13, f. Elicotteri.

45 Cigerza to Rome, Prot. n° 2366/32.1/CMT, December 16, 1960, ACS, MDA, USG, 1960, b. 13, f. Trasporti.

46 (Giuseppe Casero) to Rome, October 20, 1961, ACS, MDA, USG, 1962, b. 3, f. Velivoli da trasporto.

a final decision, which would have been determined above all by the chances of securing an atomic warhead for the chosen weapon.[47] These topics were discussed in a meeting of the Tripartite Steering Committee held in Munich the following month.[48] In April, even though American experts were helping France study how to adapt a nuclear warhead to the AS-30, the Italian Defense Staff was more interested in the Bullpup, which was ready to safely carry a nuclear warhead.[49] During the meeting of the Tripartite Steering Committee at the end of June, France solicited Italian financial aid to foster research on the nuclear upgrade of the AS-30. Curiously, from the Italian point of view, these atomic talks were less of a national priority than assuring that the country would not be excluded from Franco-German discussions on the development of a tank.[50] Eventually, at a meeting of the trilateral Rockets and Missiles Committee in January 1963, the Italian Air Force communicated that it was not interested in French nuclear capable missiles, since it preferred weapon systems which could certainly have been delivered by the F104G Starfighter.[51]

When evaluating the significance, if any, of this nuclear rebirth or endurance, one should, first of all, wonder whether these atomic talks would ever have taken place without the existence of an overarching military body, which was almost exclusively in charge of dealing with conventional issues. One can speculate therefore that there may even be other trilateral nuclear talks that are yet to be disclosed.

Assessing the Instrumentality Thesis

The FIG accord has been interpreted, by and large, as a means to an end. The thesis of the project's instrumentality has mainly been supported by the Europeans' positive reaction to the American proposal to deploy intermediate-range ballistic missiles on the continent. An analysis of Italy's choices has been considered one of the best ways of verifying the accuracy of the instrumentality theory, since the Rome government was indeed the only one simultaneously involved in both negotiations.[52] Most probably there was an instrumental motivation in Italy's involvement in the FIG project. Taviani even

47 Foglio 3137370, February 2, 1962, AUSSME, DSSMD, III Reparto, b. 33.

48 February 17, 1962, AUSSME, DSSMD, III Reparto, b. 33.

49 Foglio 3139109, April 18, 1962, AUSSME, DSSMD, III Reparto, b. 33.

50 Promemoria, July 4, 1962, AUSSME, DSSMD, III Reparto, b. 33.

51 Foglio 132/5225/1, January 31, 1963, AUSSME, DSSMD, III Reparto, b. 35.

52 Leopoldo Nuti, "Le rôle de l'Italie dans les négociations trilatérales, 1957-1958", *Revue d'histoire diplomatique* 104 (1990): 133-58, see 151.

admitted that Fanfani might have established a nexus between FIG and the Jupiters.[53] However, primary sources often give conflicting accounts of Italy's intentions. For example, a recently declassified American document, which unfortunately is still partially sanitized, cryptically states that in FIG "Italy [was] indifferent as to which country [got] those [nuclear] weapons provided that one of the three actually [would receive] them".[54] Nevertheless, it must be stressed that an in-depth analysis has led me to the conclusion that, throughout the 1950s and beyond, Italy revealed an interest in European projects of military cooperation *per se*, and considered an eventual American counteroffer as a highly desirable but secondary consequence of each and every possible continental collaborative action.

The success of the instrumental narrative shows that historians have focused almost exclusively on the nuclear perspective of this story. Scholars have successfully identified the nuclear *arrière-pensées*, hidden in the back of the minds of European policymakers, but at a significant cost. In general, the historical literature has not given due weight to ever-present and always significant proposals for conventional military cooperation. Only a holistic approach, which embraces all facets of the FIG project, can reveal whether, when and to what extent the atomic dimension was more important than the conventional one. This hypotesis, however, is based on the disputable idea that the mostly conventional military discussions, which took place before[55] and after de Gaulle's return to power, can be ascribed to the same category of the political project to develop a European atomic bomb. This chapter supports this coexistence thesis: nuclear and non-nuclear elements were present from the start, and thus the continuation of trilateral discussions on conventional issues should not be regarded as a new or different FIG. The logical conclusion to these considerations is that European trilateral collaboration was on the whole too vast to simply be aimed at gaining American concessions. Moreover, in light of the fact that the Tripartite Military Committee lived on and functioned into the early 1970s, one must re-evaluate the trilateral collaboration as a far-reaching and long-lasting sincerely cooperative endeavor.

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53 Paolo Cacace, "Taviani, gli inglesi e la 'bomba europea'", *Nuova Storia Contemporanea* 2 (2002): 101-12, see 112.

54 (Sanitized) Airgram G-19 from Zellerbach to Dulles, January 31, 1958, NARA, FOIA, 765.5611/1-3158.

55 A line in Taviani's memoirs helps understand that, from the very beginning, discussions on conventional issues were numerically more significant and less vague than the nuclear talks: "*many* issues regarding conventional weapons were dealt with and a *possible* European atomic defense was also discussed", emphasis added; Taviani, *Politica*, 215.

Italy's Contribution

The Rome government was undoubtedly the "weakest link"[56] in a project which most probably would have gone on without her.[57] Paris and Bonn, however, preferred to include her.[58] The French, especially, were attracted by "Fermi's heritage", as Quaroni epitomized.[59] In this regard, Italy may have exercised a form of "soft power" through her scientific knowledge. However, Italy's actions and ambitions were restrained by her economic backwardness. Especially in the cooperative efforts set up by the working groups of the Tripartite Military Committee, the Italian representatives could often only envisage an episodic contribution for their country. Nonetheless, they provided invaluable[60] recommendations for the realization of projects, such as the Transall transport aircraft, which so far have only been considered as a result of Franco-German ventures.[61]

Italian government officials constantly felt the need to reassure Washington that Rome did not intend to distance herself from the Atlantic partnership. Since December 1957, the Italian Chief of the Defense Staff, Giuseppe Mancinelli, argued to American Embassy officials that the FIG alignment could serve as a "stabilizing factor [for] French policy".[62] For this reason, American Ambassador David Zellerbach deemed FIG to be "preferable to unilateral French achievement of independent strength".[63] In time, this idea would become one of the essential components of the "Quaroni plan". The Ambassador thought that Italy and Germany might help cure France's illnesses by politicizing the trilateral agreement.[64] This suggestion received mixed feelings from other diplomats. Vittorio Zoppi was the most critical and probably the most realistic in doubting that France could be restrained by transforming the limited FIG accord into a trilateral alli-

56 Leopoldo Nuti, "'Me too, please': Italy and the Politics of Nuclear Weapons, 1945-1975", *Diplomacy and Statecraft* 4 (1993): 114-48, see 122.

57 Cacace, *L'atomica europea*, 60.

58 Georges-Henri Soutou, "L'Italie et la construction européenne, vue par les français", *Storia delle Relazioni Internazionali* 13, no. 2 (1998), 14, no. 1 (1999): 419-32, see 423.

59 Quaroni to Carlo Alberto Straneo, 11071, September 7, 1959, ASMAE, DGAP, Ufficio I, 1945-60, vers. I, b. 20, f. 5, Germania.

60 Cigerza to Rome, Prot. n° 2330/321/CMT, November 9, 1960, ACS, MDA, USG, 1960, b. 13, f. Trasporti.

61 Soutou, *L'alliance*, 142.

62 Tel. 1983 from Zellerbach to the Secretary of State, December 5, 1957, NARA, RG 84, Italy, U.S. Embassy, Rome, Classified General Records, 1946-1964, box 90, f. 320.1 – NATO.

63 Tel. 2368 from Zellerbach to Dulles, January 17, 1958, NARA, FOIA, 740.56/1-2758.

64 Quaroni to Giuseppe Pella, Ris. 0429, March 28, 1958, ASMAE, APA, b. 83, 1° sf. R.11/7-7 accordo a tre.

ance.[65] However, to a certain extent, a diluted version of the "Quaroni plan" was eventually incorporated in Italian foreign policy when Fanfani tried to re-launch the tripartite project as an instrument of political cooperation.[66] In mid-December, the Italian Prime Minister even told Adenauer that, if the three Defense Ministers had followed political directives all along, the whole mess of atomic weapons production could have been avoided.[67] In retrospect, Taviani would also recognize that the weakest aspect of this endeavor had been the lack of a "political supporting structure".[68]

While the true intentions of Fanfani are still unclear, his Defense Minister, Antonio Segni, was a strong supporter of the trilateral agreement.[69] Ambassador to the United States Manlio Brosio continued to be one of the most determined champions of the project, to the point of almost becoming obsessed with the idea of a European atomic bomb. In February 1960, he explicitly recalled the 1957 protocol signed by Taviani, knowing that this would make him unpopular.[70] However, it was confided to him in late May 1962 that many in Rome, including Fanfani, thought that a European atomic weapon could be the utmost catalyst for continental integration.[71] This is why exactly a year later he opposed the Multilateral Force, which would have prejudiced "the European nuclear weapon and thus the political unity of Europe".[72]

In September 1959, Quaroni believed that Italy could potentially still convince France to re-enlarge the trilateral cooperation to the atomic realm. This opinion was illusory. What is revealing though in Quaroni's analysis is the impossibility for the Rome government to encourage such a development due to her domestic politics.[73] Further research is required to understand precisely what the Italian Ambassador meant when he referred to internal constraints on Rome's foreign policy.

New evidence would seem to reveal that, even if "Italy was not really directly interested in this [nuclear arms] field", Taviani was still willing to "help France with her nuclear program".[74] The Italian Defense Minister even hoped that the "US would decide to assist France in such [a] manner that its nuclear capability could be shared with Germany

65 Letter from Vittorio Zoppi to Pella, ris. 1981/1219, April 16, 1958, ASMAE, APA, b. 83, 1° sf. R.11/7-7 accordo a tre.

66 Adolfo Alessandrini to several Embassies, Telespr. 4/795/C, September 9, 1958, ASMAE, APA, b. 84, f. R-12/12.

67 Fanfani, *Diari*, 468.

68 Taviani, *Politica*, 217.

69 Brosio, *Diari di Washington*, 384.

70 Brosio, *Diari di Washington*, 493.

71 Manlio Brosio, *Diari di Parigi, 1961-1964* (Bologna: il Mulino, 2009), 200.

72 Brosio, *Diari di Parigi*, 348.

73 Quaroni to Straneo, September 7, 1959, ASMAE, DGAP.

74 Tel. 2839 from John D. Jernegan to Dulles, March 18, 1958, NARA, FOIA, 740.56/3-1858.

and Italy", by arguing that the "importance of Italy in a Tripartite arrangement was primarily to provide political 'ballast'".[75] Notwithstanding all these sincere demonstrations of Atlantic loyalty, Ambassador Zellerbach believed that "the Italians … did not wish … to be excluded[,] were a FIG nuclear scheme developed", even though they "could contribute neither substantial funds nor great technical talent to a nuclear program".[76]

Even though Italy's participation in the FIG project can fundamentally be considered as an exception in an otherwise linear path of bilateral atomic cooperation with the United States, Rome's effort in this trilateral undertaking should, at the same time, be *exceptionally* revealing of her long-lasting attitude in atomic military affairs: by trying to combine conflicting policies and not fully accepting the consequences of her domestic misgivings, Italy could never fully contribute or achieve as much as she desired.

A Never-Ending Story

On the one hand, this chapter brings to light new aspects of the nuclear side of the FIG story. On the other hand, however, it unveils arguably more important non-nuclear elements. The far-reaching and labyrinthine activities of the Tripartite Military Committee could probably be much more significant for the history of European integration than for nuclear history. It is worth investigating whether an identity card[77] was released to some of the participants to the countless tripartite working groups.[78] If this were the case, the Tripartite Military Committee could have constituted an example of a "transnational network of scientists, engineers, military officers", capable of favoring the "circulation of knowledge and skills";[79] "the role of a culturally embraced idea of belonging together"[80] certainly influenced the actions of Italian Air Force General, Enrico Cigerza, whose ultimate goal was to promote the "spirit of the Tripartite Pact wanted by the three Defense Ministers for the best future of the union for the defense of Europe".[81]

Discovering that the Tripartite Military Committee continued to exist until the early 1970s leads to a bitter conclusion. According to the fifty-year rule usually applied to

75 Tel. 2410 from Zellerbach to Dulles, January 30, 1958, NARA, FOIA, 740.56/1-3058.

76 Memorandum of Conversation, March 19, 1958, NARA, FOIA, 740.56/3-1958.

77 An interview with retired Italian Air Force General Domenico Spinelli, who participated in several meetings of the 'Air' Commission, has not been able to confirm this information.

78 Compte rendu de la réunion, 27 et 28 mars 1958, ACS, MDA, USG.

79 Helmuth Trischler and Hans Weinberger, "Engineering Europe: Big Technologies and Military Systems in the Making of the 20th Century Europe", *History and Technology* 21, no. 1 (2005): 49-83, see 71-72.

80 Trischler and Weinberger, "Engineering Europe", 74.

81 Cigerza to Rossi, Prot. 37/S, June 16, 1958, ACS, MDA, USG, 1961, b. 3, f. 0.8.1/2 Allegati.

military documents, many key facts of these important tripartite activities are still classified and may remain a mystery for approximately another decade. Although this chapter argues that the atomic side of FIG should be recast in its proper context, without overshadowing the conventional dimension of the project, it is possible that, in time, nuclear sensitive information from the late 1960s or early 1970s will be disclosed. Due to clear *lacunae* in the files currently accessible, it is also reasonable to assume that many significant aspects of the latent nuclear dimension from the late 1950s or early 1960s still could be revealed. However, there is cause for hope, as my numerous derogation requests to access files containing tripartite military documentation, stored at the Service Historique de la Defense in Vincennes, have been approved, with the notable exception of the records of the Nuclear Biological Chemical (NBC) protection working group. In conclusion, potentially withheld atomic sides of the FIG triangle could be dug out from international archives with a more permissive access policy than the restrictive one currently in place in Italy. Unfortunately, a complete investigation of Italy's contribution to FIG is currently almost impossible, and a full narrative of the country's role may prove to be a never-ending story.

Leopoldo Nuti

Italy as a Hedging State? The Problematic Ratification of the Non-Proliferation Treaty

The signature and the ratification of the nuclear Non-Proliferation Treaty (NPT) were some of the most difficult foreign policy decisions the Italian government had to face after the crucial choices of the early postwar years. This chapter is an attempt to provide a plausible explanation for the intensity of the debate that the Treaty stimulated, and more specifically for the actions that the Italian government took during the long delay between the Italian signing (1969) and the ratification (1975) of the Treaty. In order to do so, it briefly describes in an introductory paragraph the Italian approach to the growing importance of nuclear weapons in international relations since the mid-1950s, as well as the remarkably hostile reaction to the NPT. It then focuses on all the parallel efforts to bolster Italy's status in such fields as uranium enrichment and nuclear naval propulsion. A final section looks at the diplomatic maneuvers and at the vitriolic dispute about ratification that took place in 1974-1975.

General Survey

From the mid-1950s the Atlantic Alliance's increasing reliance on nuclear weapons generated serious concern in the Italian government. Always very sensitive to their country's ranking in the international system, Italian diplomats realized rather early on that the strategic choices of the Dwight D. Eisenhower administration threatened to reinforce the existing hierarchy among North Atlantic Treaty Organization (NATO) members. The countries which had some form of access to the new weapons would inevitably be placed in a position of higher responsibility inside the alliance, as they would be the ones who would make the crucial decisions about their use in case of war; while NATO non-nuclear members would be further sidelined. Such a challenge ran against one of the main goals of postwar Italian foreign policy, namely the restoration of a position of parity with the other European powers.

The solution that the Italian government developed to meet this new challenge was to resort to the same multilateral approach which had become one of the hallmarks of its foreign policy since the late 1940s. In order to achieve a nuclear status, Italy should rely on a strategy of cooperation, mainly with the United States but also, if and when possible, with other Western European countries. This policy was based on the assumption that the United States would eventually share its weaponry with its allies and that NATO would be the logical framework to establish some form of multilateral nuclear integration. Consequently, throughout the 1950s all the Italian governments repeatedly accepted the deployment of US atomic weapons on Italian territory. At the same time, the lingering doubt that the United States might *not*, after all, decide to fully share its nuclear technology made Italy pursue a parallel track. A possible European cooperation on the military applications of nuclear energy seemed a logical step, albeit not always an easy one, for a country which was deeply committed to the construction of Europe and which was already engaged in building a European Community for the civilian use of the atom. The idea of a European bomb, therefore, was constantly looming in the mental landscape of the Italian foreign policy-making elite: sometimes as an alternative to the Atlantic one, when the United States seemed to backtrack from a policy of nuclear sharing, sometimes as the necessary step to reinforce the European pillar of the Alliance. What was clear, in any case, was that a *national* choice seems to have been repeatedly excluded. The available documentation shows that whenever nuclear issues were discussed at the highest level by the Supreme Defense Council, the conclusion was always the same: no single NATO country in Europe could afford to deploy an effective atomic deterrent all by itself. Hence a collective effort was needed, with much support from the United States, which had to be convinced that an integrated Atlantic force was in everybody's best interest.[1]

This policy did not change even if by the early 1960s the John F. Kennedy administration took a much more hesitant approach to nuclear sharing. Perplexed as they were by a number of choices that the US government took, Italian diplomats saw no alternative to relying on its major ally for achieving a nuclear status. Uninspiring as it might have been, the Multilateral Force proposed by the Kennedy administration had to be accepted without too many illusions, wrote the Ambassador to the North Atlantic Council, Adolfo Alessandrini: it was "the only possible way we can insert ourselves, namely through the cooperation with the United States, in the world of nuclear strategy".[2]

1 Minutes of the Meeting of December 10, 1960, Archivio Storico Presidenza della Repubblica, Roma, Italia (hereafter ASPR), Verbali delle sedute del Consiglio Supremo di Difesa.

2 Adolfo Alessandrini al ministro degli Esteri, Attilio Piccioni, e al Presidente della Repubblica, Antonio Segni, 23 luglio 1963, ASPR, Ufficio del Consigliere Diplomatico (hereafter UCD), busta (hereafter b.) 94.

The same attitude shaped the Italian response to the proposal of US Secretary of Defense Robert McNamara to strengthen the Alliance's nuclear planning process. Until the very end of 1966, therefore, Italian nuclear aspirations were centered around the principle of achieving some sort of parity with the other major European countries inside NATO. What is more important, arms control and disarmament policies were supported but with the clear understanding that they should not jeopardize the country's aspirations. "Our goal is disarmament", said Italian President Giovanni Gronchi to the Supreme Defense Council in December 1957, "but as long as we do not get there, we have the duty to adequately defend ourselves". And as late as June 1966, the point was firmly repeated by Prime Minister Aldo Moro in his instructions to the Foreign Minister, Amintore Fanfani: none of the disarmament proposals discussed at the 18 Nations Disarmament conference in Geneva should affect the "collective nuclear projects" that Italy supported.[3]

This world view, and the assumptions on which it was based, came under severe strain by late 1966, when the United States circulated a new draft for a non-proliferation treaty at the Geneva conference. The document basically cut the Gordian knot between nuclear sharing and non-proliferation by making clear that the United States preferred the latter to the former, much to the chagrin of its non-nuclear allies. Finally accepting the Soviet point of view that the dissemination of nuclear weapons inside NATO was indeed a case of proliferation, the new draft clearly stated in article 1 that nuclear states should not transfer nuclear weapons "to any recipient whatsoever" – a comprehensive formulation which clearly included the Atlantic Alliance. As more contents of the new draft became known, the Italian government was horrified to discover that many of the premises on which its nuclear aspirations had been conceived were being wiped out by none other than its foremost ally. The indignant reactions by most politicians and diplomats show how widespread this feeling of betrayal was, from the President of the Republic to most of the diplomatic corps. At the same time, while there were some grumblings about a *national* option or a possible rejection of the treaty, the official position of the government was to change as much of the new US draft as possible but without opting for any radical alternative. For the next two years, until it signed the NPT in January 1969, the Italian government saturated the Lyndon B. Johnson administration with a plethora of requests for modifying the treaty, perhaps secretly hoping that its demands would help make sure that it never saw the light.

3 Minutes of the Meeting of the Supreme Defense Council, December 11, 1957, ASPR, Verbali delle sedute del Consiglio Supremo di Difesa; Aldo Moro to Amintore Fanfani, June 25, 1966, Archivio Aldo Moro (hereafter AM), Archivio Centrale dello Stato, Roma, Italy (hereafter ACS), b. S4, f. NATO, sub folder Questioni generali. I discuss all these issues more in depth in Leopoldo Nuti, "'A Turning Point in Postwar Foreign Policy': Italy and the NPT Negotiations, 1967-1969", in *Negotiating the Nuclear Non-Proliferation Treaty: Origins of the Nuclear Order*, ed. Roland Popp, Liviu Horovitz, and Andreas Wenger (London and New York: Routledge, 2017), 77-96.

An Expanding Array of Nuclear Activities

At the same time, the government and the Comitato Nazionale per l'Energia Nucleare (CNEN) stepped up the *tempo* of Italian activities in the civilian nuclear sector. This can be explained by a number of reasons which apparently have little to do with the NPT: some of these initiatives, as a matter of fact, might have taken place even if there had been no treaty at all, and they may be interpreted as the results of independent historical and technological processes. The coincidence, however, is truly remarkable, and what limited documentary evidence is available makes one wonder if the government authorized the CNEN to probe the limits of the nuclear order which was being created under the NPT. In an aide-memoire which was handed over to the Director of the US Arms Control and Disarmament Agency (ACDA) William Foster in March 1967, for instance, the Italian government raised several questions about what specific technological developments the NPT could or could not banish.[4] Two of these points, in particular, are worth exploring more in depth, as they clearly reflect the Italian aspirations to play a larger role in nuclear matters – namely joint enrichment projects and naval propulsion.

At the crucial time when the negotiations for the NPT were coming to a head, there was a strong resurgence of interest in uranium enrichment across Western Europe. From a technical and economical point of view, there was a concrete fear of a bottleneck in the fuel supply for what seemed at the time the growing demand of the European nuclear sector. By the mid-1960s, almost all the nuclear fuel for European reactors was safeguarded natural uranium coming from the United States through a US-Euratom agreement. The United States, however, was planning to switch from natural uranium reactors to light water ones which would require enriched, rather than natural, uranium as its fuel. The Europeans, who planned a similar switch, worried lest in the future the United States might not be able to produce the increased amount of low enriched uranium (LEU) necessary to support their own expanding nuclear sector.[5] On top of all this, the impact of the June 1967 Six-Day War and the consequent threat of a critical shortage of Middle Eastern oil supplies hastened the European interest in a possible independent source of nuclear fuel.

Almost simultaneously, one of the major obstacles to the construction of a European separation plant was about to be removed by a remarkable technological shift. Until then, the sheer cost of building a gaseous diffusion plant had been one of the reasons

4 Note "Considerazioni preliminari sulle risposte americane al questionario tecnico da noi consegnato al Signor Foster", April 8, 1967, ASMAE, Fondo (collection) Bettini, b. 1.

5 Jean-Pierre Daviet, *Eurodif 1973-1993. Histoire de l'enrichissement de l'uranium* (Bruges: Fonds Mercator, 1993), 319.

which had tempered the European interest in having an independent source of enriched uranium. By the mid-1960s, however, a number of European governments had made significant inroads into the new technique of centrifugal separation, which promised to be remarkably cheaper than its previous alternative. By early 1967 the British, the Dutch and the German governments had all reached this conclusion and the last two had actually said so in public in a meeting of the European Atomic Forum (FORATOM), the association of European nuclear industries.[6] The three governments would soon start a negotiation to set up a joint consortium that eventually led to the treaty of Almelo in 1970 and the establishment of Uranium Enrichment Consortium (URENCO).[7]

A whole web of parallel and multilateral negotiations accompanied these developments. At the end of 1965, the British suggested reactivating and expanding their gaseous diffusion plant at Capenhurst and asked the West German government whether it might be interested in participating in the project.[8] In May 1967 the Germans enquired whether the French might be interested in expanding their own military enrichment plant at Pierrelatte into a civilian facility with German support,[9] and at the end of the same month the Euratom Commission approved a memorandum which officially recommended the creation of a European enrichment plant. The rise in the number of light water-enriched uranium reactors, the memo argued, would put a strain on the capacity of the US fuel supply to Europe, and neither the expansion of Capenhurst nor that of Pierrelatte, if done at a national level, would be able to meet the resulting gap.[10]

As these projects unfolded, in June 1967 the CNEN approved a document which made clear its interest in the long-term procurement of uranium supplies, including the participation in international initiatives.[11] Simultaneously, the CNEN's director for

6 John Krige, "The Proliferation Risks of Gas Centrifuge Enrichment at the Dawn of the NPT", *The Nonproliferation Review* 19, no. 2 (2012): 219-27, see 223. For more background, see R. Scott Kemp, "The End of Manhattan: How the Gas Centrifuge Changed the Quest for Nuclear Weapons", *Technology and Culture* 53, no. 2 (2012): 272-305.

7 R. B. Kehoe, *The Enriching Troika: A History of Urenco to the Year 2000* (Marlow: URENCO, 2002).

8 Susanna Schrafstetter and Stephen Twigge, "Spinning into Europe: Britain, West Germany and the Netherlands: Uranium Enrichment and the Development of the Gas Centrifuge 1964-1970", *Contemporary European History* 11, no. 2 (2002): 253-72, see 256.

9 Daviet, *Eurodif*, 319.

10 Tel. 6869 from AmEmbassy Brussels to the State Dept., June 21, 1967, National Archives and Records Administration, Washington, DC (hereafter NARA), RG 59, CFPF 1967-1969, b. 2897, f. AE 11-2 Euratom. For an analysis of the Commission's role, see Mauro Elli, "Between Industrial and Energy Policy: The Issue of the European Capacity in Uranium Enrichment, 1969-1974", in *The Road Europe Travelled Along: The Evolution of the EEC/EU Institutions and Policies*, ed. Daniela Preda and Daniele Pasquinucci (Bruxelles: Peter Lang, 2010), 383-94.

11 Silvio Labbate, *Il governo dell'energia. L'Italia dal petrolio al nucleare (1945-1975)* (Firenze: Le Monnier, 2010), 108-09.

external relations, Achille Albonetti, outspokenly advocated the creation of a European separation plant. It was a necessary step, he wrote in a number of editorials, to give Europe the necessary independence in such an advanced technological field and to bridge the growing gap between Europe and the United States.[12] He even hinted that such a nuclear Europe could develop its own weapons and use them as leverage to obtain the disarmament of the other nuclear powers. Even if this ambitious military goal could not be accomplished, Europe still needed a joint enrichment plant, and any opportunity had to be exploited. In one of his articles, for instance, he encouraged the United Kingdom to share its nuclear know-how and its nuclear hardware with its European allies.[13]

The other key figure to fully endorse a European plant was the Minister of Industry and President of the CNEN, the influential Christian Democrat (DC) politician Giulio Andreotti. At the December 1967 Euratom Council meeting, he strongly declared his approval of such an initiative, and he seems to have been the main supporter of the Council's decision to set up a study group to assess Europe's supply situation as well as to make some recommendations on the matter.[14] Simultaneously, at the national level he urged the CNEN "to take action as soon as as possible" in the field of securing uranium supplies, because "there was a remarkable flourishing of initiatives worldwide" and "by waiting any longer, there was a risk of finding all possible channels closed".[15] By the end of 1967, there was enough interest in uranium enrichment for the CNEN to decide to create an inter-governmental agency, the Gruppo Italiano Arricchimento Uranio (GIAU), with the task of coordinating the research and the initiatives of all the private and public companies working in this field.[16] On August 2, 1968, the Government's Comitato Interministeriale per la Programmazione Economica (CIPE) officially decided that Italy should participate in the construction of a European enrichment plant, stating that such an opportunity could not be missed.[17] Not long afterwards, the CNEN also started exploring the opportunity to cooperate with the United Kingdom in the field of centrifugal separation. By the end of 1968, the British hinted to the Italians

12 Achille Albonetti, "Produrre uranio", *L'Europa* 1, no. 5 (October 13-20, 1967).

13 Mario Silvestri, *Il costo della menzogna. Italia nucleare 1945-1968* (Torino: Einaudi, 1968), 379-81.

14 Silvestri, *Il costo*, 376-77; Steven Jerrold Baker, "Technology and Politics: The Italian Nuclear Program and Political Integration in Western Europe" (Ph.D. diss., University of California at Los Angeles, 1973), 168.

15 Verbale della 136 Riunione della Commissione Direttiva del CNEN, December 15, 1967, Archivio Carlo Salvetti, Università di Roma "La Sapienza", Dipartimento di Fisica.

16 The chairmanship of the new Committee was given to Piero Caldirola, one of Italy's foremost physicists. Caldirola was a leading figure at the University of Milan and, since 1961, the Scientific Director of the Research Reactor of the CAMEN, the military center for nuclear research (see below, notes 34 and 35).

17 Appunto del Ministero degli Esteri: Arricchimento Uranio, August 3, 1973, AM, ACS, b. 162, f. vertice europeo di Copenhagen.

that they were willing to discuss the possible participation of any fourth country to the tripartite arrangement they had been negotiating with the Germans and the Dutch. The Italians were pleased and took the offer very seriously, declaring that they wished to be considered as “full partners from the start”.[18]

Both these initiatives failed. The Euratom idea never really took off, repeating the fiasco of the first attempt which had taken place during the treaty negotiations in the mid-1950s. As for joining URENCO, the British seemed interested in opening up the partnership to the Italians but met with a certain resistance from the other two members of the consortium, who were not ready to grant Italy a full affiliation.[19] Italy (and Belgium) were invited to “associate” themselves with the other three countries “through a 10 per cent in the Enrichment Organization and 5 per cent in the Prime Contractor”, but were excluded by the policy-making Joint Committee.[20] The risk of joining as an unequal partner, coupled with some perplexities about the ultimate success of a new technology, toned down the Italian interest in the project.[21] Some lengthy negotiations eventually succeeded in defining the draft of a possible intergovernmental agreement between the URENCO group and Italy, and by late 1973 Albonetti wrote to Andreotti that he saw some indication that the three partners might eventually change their attitude vis-à-vis a full Italian membership. For the time being, however, Albonetti recommended that it would not be wise to rely entirely on such a flimsy perspective, particularly because there was another opportunity to enter the field of uranium enrichment as a full partner of another consortium.[22]

In June 1971, as a matter of fact, the Italian government had approved the development of a parallel negotiation to associate Italy with another project in the field of uranium enrichment, and entered a negotiation with the French Commissariat à l’Energie atomique (CEA) to define the possible participation in the French project for the expansion of Pierrelatte, what would later be called EURODIF.[23] In December 1971, the Italian Parliament approved a law which restructured the CNEN and allowed it to participate in international consortia working on the industrial development of peaceful uses

18 “Italy and the Centrifuge Organization”, note by G. P. C. Macartney, August 30, 1972, UK National Archives (hereafter UKNA), FCO 55-933 Participation of Italy in tripartite centrifuge arrangement.

19 Memo by G. P. C. Macartney, “Italy and the Centrifuge Organization”, August 30, 1972, UKNA, FCO 55, FCO 55-933.

20 Baker, “Technology and Politics”, 156.

21 *Appunto* by Achille Albonetti to Giulio Andreotti, November 29, 1973, Archivio Giulio Andreotti, Istituto Luigi Sturzo, Roma, Italia (hereafter AAn), Fondo USA, b. 621, f. Viaggio G. A. dicembre 1973.

22 *Appunto* by Albonetti to Andreotti, November 29, 1973, AAn, Fondo USA, b. 621, f. Viaggio G.A. dicembre 1973.

23 *Appunto* by Ministero degli Esteri: Arricchimento Uranio, August 3, 1973, AM, ACS, b. 162, f. vertice europeo di Copenhagen.

of nuclear energy. In January 1972, the CNEN and the CEA signed a memorandum of understanding which granted Italy a participation in 22.5 per cent of EURODIF's activities, a quota that would be later extended to 25 per cent when Sweden opted out of the consortium. By the end of the following year, the Italian government was called to make the final decision about financing its share of the project, and Albonetti wrote to Andreotti to recommend reaching a positive conclusion as quickly as possible.[24] After a somewhat difficult debate, the CIPE approved the memorandum on Christmas Eve, 1973. Albonetti actually believed that the Italian decision rescued the entire project, as the French initiative seemed to be faltering if no other major European partner decided to support it.[25]

Clearly, Italy tried hard to join *both* projects, and above all it considered it of paramount importance to avoid any fracture between them. According to a 1973 Foreign Ministry memo, the Italian goal was actually to eventually merge the two projects into a common European agreement.[26] This broad approach was confirmed by the fact that Italy also joined the Association for Centrifuge Enrichment, an international study group on various aspects of centrifuge plant usage (including technology, construction, and finance) that was set up at Eton on June 1, 1973 partly to reply to an initiative from the European Community (EC) Commission that was trying to reconcile all the different projects.[27]

What needs to be highlighted in the context of this chapter is the coincidence of the upsurge of a strong interest in the field of enrichment with the progress of the negotiations of the NPT. This acceleration was certainly influenced by all the economic and technological factors discussed at the beginning of this paragraph, but the impact of the concerns engendered by the NPT should not be underestimated. In April 1967, for instance, an internal Foreign Ministry memo stressed that the NPT draft would impose a number of severe controls on any Italian initiative in the field of uranium enrichment or of plutonium reprocessing.[28] And in 1973 the Foreign Ministry highlighted the need for Europe to have an autonomous enrichment capacity which would make it fully

24 *Appunto* by Albonetti to Andreotti, November 29, 1973, AAn, Fondo USA, b. 621, f. Viaggio G.A. dicembre 1973.

25 Achille Albonetti, *L'atomica. L'Italia e l'Europa. Intervista di Leopoldo Nuti* (Roma: Edizioni Europa, 2014), 97-98.

26 *Appunto* by Ministero degli Esteri: Arricchimento Uranio, August 3, 1973, AM, ACS, b. 162, f. vertice europeo di Copenhagen.

27 Elli, "Between Industrial and Energy", 386; Allan S. Krass, Peter Boskma, Boelie Elzen, and Wim A. Smit, eds., *Uranium Enrichment and Nuclear Weapons Proliferation* (London-New York: Taylor and Francis, 1983).

28 *Appunto* "Considerazioni preliminari sulle risposte americane al questionario tecnico da noi consegnato al Signor Foster", April 8, 1967, ASMAE, Fondo Bettini, b.1.

independent from any existing oligopolies – a belief which, as we have seen, was firmly shared by Albonetti as well.[29]

A similar determination can also be seen at the research and development level. Throughout these years, Italy developed an intense enrichment research program, with the CNEN studying and producing a number of components for a gaseous diffusion plant (in particular, compressors and barrier supports, but also less technologically advanced equipment), while also continuing to carry out its own research on centrifuges. As long as there was no certainty that EURODIF would actually see the light, the CNEN worked on centrifuges with some alacrity, in order "to demonstrate the feasibility of machines which, despite their low unit capacity", might allow the production of enriched uranium at relatively accessible market prices. According to a 1977 report, the objective was reached "in part with the tests on separation in UF/6 of machines with small-size steel rotors, thus making it possible, also, to test theoretical forecasts and acquire an understanding of the process as a whole". After EURODIF was created, however, research on centrifuges continued at a slower pace, and was gradually placed on the back-burner but not totally abandoned. Some interesting work was also done on the design of a pilot cascade plant for a few hundred machines.[30]

Italy had also been active in the field of fuel reprocessing for quite a while. Italian technicians had worked from the very beginning in the Organisation for European Economic Co-operation's Eurochemic plant,[31] and in 1970 the CNEN had inaugurated its first pilot national reprocessing plant, EUREX I, at Saluggia. The plant had been designed specifically to reprocess the highly enriched uranium fuels used in research reactors, and according to one estimate its plutonium extraction capacity varied from 8 to 200 kg of plutonium a year.[32] A second pilot plant was built at the CNEN Trisaia center to study "fuel reprocessing and refabrication techniques related to the thorium-uranium cycle, as an alternative to the U-Pu cycle", but after a troubled start it was decommissioned shortly after its completion. By 1974, however, both EUREX and the former Trisaia center (now renamed Impianto Trattamento Elementi Combustibili, ITREC) were "commissioned to start a wide range of experimental activities in the field, of the

29 *Appunto* by Ministero degli Esteri: Arricchimento Uranio, August 3, 1973, AM, ACS, b. 162, f. vertice europeo di Copenhagen; *Appunto* by Albonetti to Andreotti, November 29, 1973, AAn, Fondo USA, b. 621, f. Viaggio G. A. dicembre 1973.

30 P. Bullio, P. Caldirola, F. Fraschetti, M. Leboffe, G. B. Scuricini, "Italian Activities in the Field of Uranium Enrichment", in *International Conference on Nuclear Power and Its Fuel Cycle, Salzburg, Austria, May 2-13, 1977* (Vienna: IAEA, 1973), 183-201, IAEA-CN-36/311.

31 Jean-Marc Wolff, *Eurochemic (1956-1990): Thirty Five Years of International Cooperation in the Field of Nuclear Engineering: The Chemical Processing of Irradiated Fuels and the Management of Radioactive Wastes* (Paris: OECD, 1996).

32 Baker, "Politics and Technology", 192.

power reactors oxide fuel reprocessing and, respectively, fast reactor fuel reprocessing. To support these pilot plant activities an adequate research and development work at laboratory scale was also implemented".[33] According to a 1977 study, the goal of the new range of activities was to develop "the necessary experience and knowledge which would allow [the Italian] domestic industry to design, build and operate a commercial size reprocessing plant when, by the late 1980s, this plant will be justified by the extent of the Italian nuclear program". A much larger reprocessing plant, EUREX II, had in fact been planned to be operational by around 1985.[34]

Finally, it should be pointed out that in 1955 the Ministry of Defense had created a Centro per le Applicazioni Militari dell'Energia Nucleare (CAMEN), in Pisa, which was operated jointly by the Naval Academy and by the University of Pisa. After a somewhat uncertain start, in 1957 the Center's activities took off and shortly afterwards it was supplied with a swimming pool research reactor by the US firm Babcock & Wilcox.[35] The reactor went critical on April 4, 1963 and reached its maximum power of 5MW in 1967. The Center, on which there is a very limited literature, seems to have focused most of its research around the reactor itself, the study of naval propulsion, and the diffusion of radioactivity.[36]

Naval Propulsion

In his October 1967 article, Albonetti wrote that the other matter which deserved the attention of the Italian government was naval propulsion, and in the late 1960s there was indeed a remarkable intensification of Italian activities in this field as well. In December 1962 Italy had formally requested US assistance to build a nuclear submarine, but the negotiations never went anywhere, and the project was finally abandoned. In December 1966, however, the Italian ministers of Defence (Roberto Tremelloni) and of Trade and Industry (Andreotti) signed an agreement for a joint Navy-CNEN project to

33 S. Cao, G. Rolandi, R. Simonetta, and H. Dworschak, "Italian Experience with Pilot Reprocessing Plants", in *International Conference on Nuclear Power and Its Fuel Cycle, Salzburg, Austria, May 2-13, 1977* (Vienna: IAEA, 1977), 547-59, IAEA-CN-36/304.

34 Baker, "Politics and Technology", 191.

35 The story of how a military center could be supplied by the United States with a research reactor without violating the regulations on nuclear exports is fairly complicated. See Memorandum by Algie A. Wells, AEC Division for International Affairs, to Philip Farley, Dept. of State, January 30, 1963, in NARA, RG 59, lot file General Records relating to Atomic Energy Matters 1944-1962, b. 503, f. 21.51 Country file Italy, h. Reactor 1957 & 1962.

36 Amerigo Vaglini, *Il nucleare a Pisa. Quaderno di memorie storiche sul CAMEN, 1955-1985* (Pisa: ETS, 2009), 55.

develop a nuclear propelled surface ship. The US State Department informed the Italians that the mixed civilian and military nature of the vessel was likely to raise a strong Congressional opposition, and suggested leaving the Navy out of it.[37] The CNEN replied with a detailed memo which explained the nature of the initiative, specifying that the future reactor would be a pressurized light water one, requiring low enriched uranium at 4.7 per cent. The ship would be a "logistical supply ship", any information provided by the United States should not be classified, and if necessary Euratom safeguards could be applied to any nuclear fuel the United States could provide. The only concession that Italy could not afford to make, the memo continued, was about the participation of the Italian Navy, which was necessary because only the Defense Ministry could supply the required funding for the project.[38] In April 1967, Albonetti and Rear Admiral Luigi Tomasuolo went to Washington to continue the negotiations, but they met with a stiff resistance.[39] Faced with such a negative outcome, Andreotti expressed the intention to launch a broader effort to find the required LEU for both the critical test and the regular future supply of the reactor.[40] Albonetti then approached the Director of the UK Atomic Energy Authority Overseas Relations Office, J. L. Croome, to enquire about the possible price of the materials necessary for "the performance of a critical experiment, the irradiation tests of fuel elements, the fabrication of the first reactor core".[41] Similar requests were also sent to the US Atomic Energy Commission (USAEC) and the CEA.

The British government took a long time to reply. As one Foreign Office (FO) official aptly noted, the United Kingdom found itself "caught in the cross fire of [its] European Common Market and Anglo-American interests".[42] All the participants in the debate inside the British government stressed the obvious linkage among the possible nuclear fuel supply to Italy and the parallel negotiations about the NPT and the joint enrichment plants. "Our hope of associating European countries in the development of Capenhurst as a European source of enriched uranium will be damaged if we refuse to assist the Italians in this case", noted a memo by one of the supporters of the Italian request. "If we

37 Tel. 135835 from the State Dept. to the Embassy in Rome, February 13, 1967, NARA, RG 59, CFPF 1967-68, b. 1560, f. DEF 12 IT.

38 Airgram A-932 from the Embassy in Rome to the Dept. of State, "Italian request for nuclear fuel", April 14, 1967, NARA, RG 59, CFPF 1967-68, b. 1560, f. DEF 12 IT.

39 Silvestri, *Il costo*, 385-86. See also The Department of State During the Administration of President Lyndon B. Johnson, vol. I, Administrative History, ch. 3, Part D, Bilateral Relations with Western Europe – Italy, in DDRS, 1985/2834.

40 Appunto per l'ambasciatore Ortona, 5 giugno 1967, ASPR, Ufficio Consigliere Diplomatico, b. 153.

41 Letter from Albonetti to J. L. Croome, July 31, 1967, UKNA, EG 8, f. 43 "Export of enriched uranium for Italian nuclear ship".

42 Letter from Robert Press (Cabinet Office) to J. L. Croome, UKAEA, August 23, 1967, UKNA, EG 8, f. 43 "Export of enriched uranium for Italian nuclear ship".

do not supply, … France as a good European might make material available if only to show the UK as a bad European". A denial, the memo concluded, "would be interpreted by the Italians as discriminatory and against their interests. Their willingness to sign a Non-Proliferation Treaty would hardly be enhanced".[43]

The British and American vacillations greatly annoyed Albonetti. When he visited London in October 1967, he accepted Croome's official explanation for the delay, but also restated his firm intention to go ahead in one direction or the other, adding that he:

> felt that they could not be entirely dependent on others for supplies of enriched materials for nuclear ships, whether for marine or naval purposes. Privately off the record, he added some fairly intemperate remarks about the attitude of the Americans. … he had also made enquiries in France and he thought that the French would be prepared to supply their requirements in exchange for plutonium derived from Latina.[44]

Such an irritation was apparently quite widespread among the diplomatic corps. The Director of Euratom and Atomic Energy Affairs at the Foreign Ministry, Counselor Stefano D'Andrea, warned a US diplomat that the fact that the United States was refusing "even" the supply for the nuclear ship would have some far reaching consequences:

> It could force both industry and the government to come to the proper conclusion that Italy must look to itself in this regard and not be in a position to be dependent on others …. The obvious step [would be] to devote enough of its own resources to produce its own enriched fuel regardless of the policies of others. … Italy might at first try to interest some of the other European countries in a joint venture but if this failed, it should be prepared to pay the cost of doing it alone. … He also mused that perhaps France was right and Italy wrong when it came to making the decision whether to be independent or dependent on others as regards supply of this material. To sum up, the US obduracy might in the end force Italy to do what it probably should have done long ago: ensure its access to enriched uranium alone or with a minimum of other co-producers.[45]

Eventually the Foreign Office agreed to offer the CNEN the LEU for the land-based critical experiment of the reactor. The Italian agency, however, replied that it was interested in the offer only if the British could also ensure the fuel for the reactor of the ship,

43 Memo attached to a letter from J. McAdam Clark to G. E. Hall, October 17, 1967, UKNA, EG 8. F. 43.

44 Letter from Croome to Hall, October 31, 1967, UKNA, EG 8. F. 43.

45 Airgram A-672 from AmEmbassy Rome to State Dept., December 22, 1962, NARA, RG 59, CFPF 1967-69, b. 1560, f. DEF 12 IT.

opening up yet another, more complicated round of negotiations. By the end of 1968, the talks became strictly interwoven with the parallel ones on centrifugal enrichment once again, and many in the FO thought it necessary to compensate the likely Italian exclusion from the trilateral consortium by meeting their demands for the ship's fuel.[46]

When the British government finally made up its mind and replied to the Italian request, it was November 1968. The CNEN, however, kept silent until August 1969, when Albonetti told the British that the CNEN and the Navy were no longer interested in their offer. The Italian authorities, he wrote, had decided to accept another offer, "considered more convenient" – which was clearly the French one, even if Albonetti did not say so explicitly.[47] It is highly plausible that the choice was influenced not only by the economic conditions which the CEA offered, but also by the fact that France was going to accept Italy as a full partner inside EURODIF, while the British could not do the same about URENCO. Eventually, the CEA agreed to supply 2,000 kilos "of 4.7 per cent enriched uranium for the research reactor and 5,000 kilos for the ship's first fuel load".[48]

Finally, it should be remembered that at about this time Italy was also involved in a specific project for the development of a national ballistic missile. Although not strictly related to the development of civilian nuclear capacities, this project is quite interesting to place all these activities in a more complex perspective. Both the Italian Navy and Air Force had shown a keen interest in rocketry from the mid-1950s, and they experimented with a variety of weapons, both national and international.[49] From the 1960s, moreover, Italy had developed a bilateral space research project with the United States, the San Marco, to build a seaborne launching facility near the Equator and to launch an Italian satellite carried by a US Scout launcher. At the same time, Italy also joined other European countries in the development of the European space organizations – European Space Research Organisation (ESRO) and European Launcher Development Organisation (ELDO).[50] By the end of the 1960s, however, the Italian Navy began to develop a special *national* project for the creation of a solid-propelled, two stage rocket, and in 1971 a Special Interforce Group was created to design such a rocket, construct

46 Letter from Fred Mulley to the Secretary of State for Defense, November 8, 1968, UKNA, EG 8, f. 44.

47 Letter from Albonetti to Coningsby Allday, August 5, 1969, UKNA, EG 8, f. 44; see also Letter to Chairman Holifield, JCAE, September 15, 1969, NARA, RG 59, CPFP 1967-69, b. 1560, f. DEF 12 IT.

48 Baker, "Technology and Politics", 128.

49 Giovanni Caprara, *L'Italia nello spazio. Storia, realizzazioni e programmi della ricerca spaziale italiana* (Roma: Valerio Levi, 1992); Alberto Traballesi, "The Italian Air Force and the Development of Space Activities", in *Italy in Space: In Search of a Strategy, 1957-1975*, ed. Michelangelo De Maria and Lucia Orlando (Paris: Beauchesne, 2008), 233-59.

50 Michelangelo De Maria and Lucia Orlando, "Preface", in De Maria and Orlando, *Italy in Space*, 7-10, see 8.

its first stage engine and test it in flight. A large number of specialized Italian defense and electronic companies were involved in the project, and by the mid-1970s the Alfa missile was completed – an 8-meter long rocket with a circumference of 1.4 meters which reportedly could deliver a one-ton warhead at a distance of 1,600 km. The missile tests all took place (successfully) in the second half of 1975 and continued until April 1976, when the program seems to have been discontinued.[51] The very limited historical literature on this topic provides no explanation for the rather abrupt termination of the project.

The Ratification Debate

By the early 1970s, Italy had signed the NPT but at the same time it had also strengthened its nuclear status across the board. More significantly, after the signature no immediate steps were taken for the ratification of the treaty. Apparently the inactivity was based on an unassailable formal justification: together with West Germany and the Benelux countries, the Italian government was committed not to ratify the NPT until Euratom had concluded an agreement with the International Atomic Energy Agency (IAEA) about inspecting all nuclear facilities in the territory of the Euratom member countries. The negotiation, however, dragged on for almost three years. An agreement was finally signed on April 5, 1973. It was a substantial diplomatic victory for the European countries, as it granted Euratom what many critics saw as basically a right to self-inspection: Euratom was recognized "as a party to the application of Article 3 of the NPT", while the IAEA was granted "a right (but not an obligation) to visit some facilities in Euratom territory, when invited to do so by the Europeans".[52] In the following months the Benelux countries ratified both the safeguards agreement and the NPT. West Germany and Italy, however, seemed to be taking a more cautious approach.

In February 1974, in particular, an inter-ministerial meeting in Rome decided to keep parliamentary actions on the safeguards agreement separated from the ratification of the NPT. The Italian Ambassador in Washington, Egidio Ortona, explained to ACDA Director Fred Iklé that the decision was taken because the government felt that the NPT ratification was a "highly-charged political question", while the safeguards

51 All the information about the Alfa missile comes from Traballesi, "The Italian Air Force", particularly 252-56.

52 Grégoire Mallard, "Crafting the Nuclear Regime Complex (1950-1975): Dynamics of Harmonization of Opaque Treaty Rules", *European Journal of International Law* 25, no. 2 (2014): 445-72; Darryl A. Howlett, *Euratom and Nuclear Safeguards*, Southampton Studies in International Policy (Basingstoke: Macmillan in association with the Centre for International Policy Studies, University of Southampton, 1990).

agreement was a relatively easy, technical issue. It was also, Ortona added, a more urgent one as it affected the supply of nuclear materials and it was of great interest for the other Euratom countries.[53]

The Italian decision to split the parliamentary debates about the two issues concealed an implicit gambit, which was made clear a few weeks later by the Foreign Ministry's Director General for Political Affairs, Roberto Ducci, in a conversation with the American Deputy Chief of Mission in Rome. By ratifying the IAEA-Euratom safeguards agreement, Ducci argued, Italy could be guaranteed all the necessary fuel deliveries and technical assistance for its civilian nuclear program, as such deliveries were covered by the US-Euratom agreement. Ratification of the NPT, on the other hand, was of no immediate urgency and Italy intended to take its time, particularly as far as the 1975 Review conference was concerned. Ducci openly admitted that he preferred to see what results the conference would produce before Italy joined the non-proliferation regime.[54] These statements raised only a limited alarm in the US Embassy in Rome, which interpreted Ducci's remarks as yet another case of Italian discomfort at being classed with the have-nots. The US Ambassador, therefore, urged nothing more than a frank clarification about the difficulties that the Italian decision might create.

The Italian opponents of the NPT, however, were clearly looking for a way to avoid an immediate ratification, and their perplexities were reinforced by the Indian Peaceful Nuclear Explosion (PNE) of May 18, 1974. The test sparked yet another round of vehement discussions, as it seemed in their eyes to confirm the substantial failure of the treaty and of the whole non-proliferation regime. A first sample of what was to come was offered once again by Ducci in a conversation with his German counterpart, Ministerialdirektor Günther van Well: Ducci argued forcefully that there was no formal link between the ratification of the safeguards agreement and of the NPT, nor was there any indication that future US deliveries of fissionable materials would be affected by a delay in the ratification of the latter. As to the risk of missing the opportunity of participating in the first NPT review conference in 1975, Ducci reacted with "scorn", countering that the conference "would not amount to anything, anyway". Upon being informed by a disconcerted van Well, this time the US Ambassador cabled the State Department recommending that the United States "now bring to bear all reasonable pressure on the Italians to submit the treaty as soon as possible".[55]

Shortly afterwards, the first public shot against the NPT was fired by no less than the Secretary General of the Foreign Ministry, Roberto Gaja, who in June 1974 published

53 Tel. 087602 from the State Dept. to AmEmbassy Rome, 29 April 1974, NARA, Central Foreign Policy Files, 7/1/1973-12/31/1979, Record Group 59 (hereafter CFPF).

54 Tel. 6225 from AmEmbassy Rome to State Dept., May 6, 1974, NARA, CFPF.

55 Tel. 08718 from AmEmbassy Bonn to State Dept., May 31, 1974, NARA, CFPF.

a couple of editorials under his customary pen name of Roberto Guidi, calling for Italy to reconsider its support for the NPT. Gaja argued that the Indian test showed that the treaty had failed in stopping proliferation and in providing adequate guarantees to the non-nuclear states. The logical conclusion that the government should draw, therefore, was that it should try to promote a substantial modification of the treaty. Italy should call for the creation of a third category of states, which he called "non-military nuclear states", namely those countries that had the technological know-how and the industrial infrastructure to quickly weaponize, but that refused to do so – a proposal which casts an interesting light on all the Italian activities described in the previous paragraph. The EC, Gaja argued, had the full right to see this status formally recognized, and Italy should work to make it happen. Something, incidentally, which he believed would also have the additional benefit of opening the door to a possible revision of the structure of the UN Security Council.[56]

Gaja's thesis was reinforced by the publication of another article by Albonetti, who pointed out that in the Mediterranean a large number of countries had neither signed nor ratified the treaty (at the time, the list included Albania, Algeria, France, Israel, Libya, Spain, Portugal and Turkey), an ominous development which he claimed posed an implicit danger for Italy.[57] Other critics joined the fray: historian Rodolfo Mosca, for instance, argued that by refusing to ratify, Italy would contribute to creating an international system which would finally overcome the rigid order created at the end of World War II, as well as strengthening European integration by re-establishing a balance between Italy and the two European nuclear powers, France and Britain.[58]

These rather nuanced argumentations were supplemented by a far more provocative publication in *Politica e strategia* – a magazine which had some dubious connections with extreme right-wing groups. In its September 1974 issue, the magazine published a special section featuring a number of essays which openly discussed the costs of national nuclear options.[59] The two most striking contributions were yet another article by Albonetti¸ "Difesa nazionale e autonomia nucleare" (National defense and nuclear autonomy), and an editorial by the magazine director, Filippo De Jorio, who unmistak-

56 Roberto Guidi, "Diplomazia nucleare", *La Stampa*, June 29, 1974; "La bomba nucleare indiana sposta gli equilibri in tutta l'Asia", *Il Globo*, July 3, 1974, both qt. in Achille Albonetti, ed., *L'Italia e l'atomica. Il governo, il parlamento, i partiti, i diplomatici, gli scienziati e la stampa* (Faenza: Fratelli Lega, 1976), 133-39.

57 Achille Albonetti, "Politica estera e proliferazione nucleare", *La discussione*, July 22, 1974, also published in *Strategia e politica*, reproduced in Albonetti, *L'Italia e l'atomica*, 71-74.

58 Rodolfo Mosca, "Il problema della non-proliferazione delle armi nucleari e l'Italia", in *Le relazioni internazionali nell'età contemporanea. Saggi di storia diplomatica (1915-1975)*, ed. Marta Petricioli (Firenze: Olsckhi, 1981), 286-87.

59 *Politica e strategia* 3, no. 8 (September 1974).

ably advocated for Italy the development of its own tactical nuclear weapons. In his own article, however, Albonetti simply listed the steps through which Italy could, if she wanted to, develop her own bomb, but did not support this choice and actually advocated once again the creation of a European nuclear force.[60]

The publication unleashed a veritable storm in the Italian media which lasted for several weeks, and in the heat of the debate all the opponents of the ratification were lumped together in an undistinguished group. Both Gaja's and Albonetti's subtleties were totally ignored and they were simply accused of supporting an Italian way to the bomb together with all sorts of right-wing conspirators and terrorists.[61] Special attention was also dedicated to the CAMEN by a bizarre left-wing magazine, *Maquis:* in a special inquiry aptly titled "Come l'Italia prepara l'atomica" (How Italy is preparing the atomic bomb), it clearly argued that the "mysterious" organization was feverishly working on an Italian device. The Director of the Centre, Rear Admiral Avogadro di Valdengo, published an interview in which he denied all the accusations, but his subsequent resignation was regarded as an indication that something wrong was afoot.[62]

The virulent debate continued throughout the Fall of 1974, in spite of a number of strong denials repeatedly issued by Andreotti, back in his previous seat of Minister of Defense. Both the United States and Italy's European allies, in the meantime, had begun to seriously worry about the possible repercussions of the Italian vacillations. The Indian test had reinforced the overall perception of the fragility of the NPT regime, and an Italian delay to ratify, not to mention an outright refusal, was seen as a potential crucial blow to its shaky foundations. In West Germany and in Japan, in particular, the NPT had been a very controversial issue, and both governments feared that an Italian refusal to join the non-proliferation regime could reopen a veritable can of worms.[63] In short, in the second half of 1974 the Italian vacillations were assuming an importance far broader than the Italian case per se, and they "could cause a very serious problem", as German Deputy Assistant Secretary of State Roth told US Counsellor Helmut Sonnenfeldt in October 1974. Both the State Department and the West German Foreign Ministry, therefore, repeatedly discussed how to coordinate their approaches to put pressure on the Italian government.[64] US diplomats tried to disabuse the Italians of any illusions

60 Achille Albonetti, "Difesa nazionale e autonomia nucleare", *Politica e strategia*, September 1974, reproduced in Albonetti, *L'Italia e l'atomica*, 152-66.

61 Vito Sansone, "Tattica e nera l'H sognata dai golpisti", *Paese sera*, December 8, 1974, reproduced in Albonetti, *L'Italia e l'atomica*, 207-09.

62 *Maquis* 2 (September 1974).

63 Tel. 55415 from State Dept. to AmEmbassy Rome, March 20, 1974, NARA, CFPF.

64 See for instance Memorandum of Conversation, October 28, 1974, NARA, RG 59, Sonnenfeldt papers (lot file 5339), Country and subject Files 1973-1976, box 3, f. Germany 1974 (1 of 2).

that the United States would automatically continue its supplies of nuclear materials to Italy even without a full ratification of the NPT.[65] As for the West Germans, they first thought about a joint *démarche* of all EC members, but then acted either alone or in coordination with the United States and the United Kingdom, pointing out to the Italian government the damage that any further delay would inflict on the Community as well as on West Germany itself.[66] Both Washington and Bonn, however, seemed to have felt somewhat uncomfortable in putting pressure on Italy, and often asked each other to take the lead.

Tension in Italy continued to mount. By the late Fall a number of parliamentarians called for an official inquiry on Albonetti, and eventually 142 of the country's leading physicists, led by such prominent figures as Guido Calogero, Edoardo Amaldi and Carlo Schaerf, addressed a letter to the Ministry of Foreign Affairs criticizing the vacillations of the Foreign Ministry and asking for the immediate ratification of the treaty.[67] Apparently, the combination of both internal and external pressures pushed the opponents of the treaty into a corner: when a new government was formed under the leadership of Aldo Moro, at the end of November 1974, its members seemed to have been "sensitized … to some of the unpleasant domestic and international ramifications of further foot dragging on NPT", as the US Ambassador John Volpe cabled to Washington. Nevertheless, in the same telegram Volpe added that there were some doubts as to where Moro himself stood on this issue, and concluded that the United States should present its view "with firmness and clarity at the political level", outflanking the main centers of resistance in the Foreign Ministry.[68] As an additional instrument "to hold the Italian government's feet to the fire", the US Embassy also recommended hinting at the fact that without a full ratification of the treaty Italy might not be admitted to the impending First Review Conference of the NPT, not even as an observer.[69]

In the early months of 1975, the new Moro government was submitted to a steady barrage of diplomatic *démarches.* The State Department reached the conclusion that "the Italian question" seemed to be arriving at its critical phase, and that its outcome might have an "overriding impact on the attitude of other states on NPT ratification – above all, Japan".[70] US Ambassador Volpe drove home the US interest for an Italian ratification of both the safeguards agreement and the NPT, first to Gaja in late January and then

65 Tel. 198749 from State Dept. to AmEmbassy Rome, September 10, 1974, NARA, CFPF.

66 Tel. 16877 from AmEmbassy Bonn to the State Dept., October 31, 1974, NARA, CFPF.

67 The signatures for the letter were collected from September 26, but the official document was submitted on December 9: Albonetti, *L'Italia e l'atomica*, 177-81.

68 Tel. 17604 from AmEmbassy Rome to the State Dept., December 20, 1974, NARA, CFPF.

69 Tel. 0676 from AmEmbassy Rome to the State Dept., January 16, 1975, NARA, CFPF.

70 Tel. 0417 from AmEmbassy Vienna to the State Dept., January 17, 1975, NARA, CFPF.

to the new Foreign Minister, Mariano Rumor, shortly afterwards; the West German Foreign Minister Hans-Dietrich Genscher paid a visit to Rumor at the end of February; and a Soviet diplomat confided to an American one that the Soviets were talking to the Italians "all the time" about the treaty. On February 19, a cabinet meeting agreed to forward the NPT to the Italian Parliament for ratification. The text was submitted on March 26, and the ratification procedure began in April. Interestingly, in order to accelerate the procedure, the Moro government also decided to handle the NPT ratification together with that of the safeguards agreement (which had been approved by the Senate but still needed the plenary assent of the Chamber of Deputies). This complete reversal of the previous delaying tactics was concluded on April 23, when Italy finally ratified the NPT, albeit with the same list of twelve "observations" that had been deposited at the time of the signing.

One particular reason which may have played a role in the reversal was the promise that Italy be assigned a "quasi-permanent" seat in the IAEA Board of Governors, a sweetening pill that according to Ducci "more or less compensated" Italy for "accepting the role of a non-nuclear power".[71] It should be noted, however, that this carrot had been accompanied by a large number of serious sticks. Before making its final decision, in fact, the Moro government had held two important meetings with the Australian Prime Minister, Edward Gough Whitlam, in late January, and with the Canadian one, Pierre Trudeau, in March. One of the key Italian goals had been to obtain a firm commitment from both visitors for the supply of uranium for its civilian program even if Italy did not ratify the NPT. Both conversations, however, fell short of the mark. The Canadian Prime Minister explicitly linked any future nuclear cooperation between the two countries to the Italian ratification of *both* agreements, and openly mentioned the negative impact of the Indian test on Canadian nuclear exports, which henceforth would be subjected to more rigorous safeguards. Whitlam, on the other hand, did not make any explicit linkage but still failed to conclude an agreement with Italy as his government had not yet established an official policy on the export of Australian uranium ore.[72] These negative results might have been the straw that broke the camel's back and persuaded the Italian government to drop its last doubts – in between the two meetings the US Embassy was still worried that Italy would ratify the treaty with some official reservations, if it did at all, and on February 7 Ducci even told ACDA Director Fred Iklé that the ratification process might take as long as another year.[73] Assessing the

71 Tel. 6389 from AmEmbassy Rome to the State Dept., May 2, 1975, NARA, CFPF.

72 Tel. 039762 from AmEmbassy Rome to the State Dept., January 15, 1975, NARA, CFPF; Visita del PM Australiano Edward G. Whitlam, AM, ACS, b. 123; Tel. 3531 from AmEmbassy Rome to the State Dept., March 11, 1975, NARA, CFPF; Visita del PM del Canada Pierre Elliott Trudeau, AM, ACS, b. 123.

73 Tel. 028268 from State Dept. to AmEmbassy Rome, February 7, 1975, NARA, CFPF.

reasons for the final decision to ratify, an internal Central Intelligence Agency (CIA) memo noted that,

> The Italians probably decided to ratify when it became apparent that they lacked support in the International Atomic Energy Agency for a legal maneuver that would have allowed them to continue receiving nuclear materials by ratifying the safeguards agreement required by the NPT, but not the treaty itself.
>
> Continued access to nuclear materials is particularly important to Rome now that it is seriously considering a plan intended to reduce dependence on imported oil through the construction of 20 new nuclear power plants by 1985. Canada, one of Italy's major potential sources for uranium, recently made it known to the Italians that their request for supplies would not be considered until Rome ratified both the NPT and the safeguards agreement.
>
> Rome must also have been influenced by its failure to get around the provision making ratification a prerequisite for full participation in the NPT review conference of May 5.[74]

The importance of a regular fuel supply was also admitted by Moro himself a few days later. The Italian Ambassador to Tokyo, Perrone Capano, had written him a personal plea "not to associate his name with such an unequal, and laden with heavy consequences, treaty such as the NPT". A few days later the Prime Minister replied listing all the reasons that had persuaded the government to ratify, and concluded that,

> Yet another reason is the necessity for Italy to purchase uranium for its civilian atomic energy program. It is a badly felt need, for the present and for the future, also in light of a possible new crisis of oil supplies. On the other hand the Western countries which supply our uranium have unmistakably conditioned their deliveries to our ratification of the NPT. Only by doing so, therefore, is it possible to ensure for Italy the development of an advanced know-how and technology, and to avoid being left in a dangerous rearguard position.[75]

Conclusion

What were the goals of the Italian government in delaying the ratification of the NPT? Without full access to the records of the Italian protagonists and of the institutions involved in this story, it is possible at best to offer a plausible thesis. The

74 "Italy finally ratifies the NPT", April 25, 1975, in Staff Notes: Western Europe, Canada, International Organizations, NARA, CREST database.

75 Amb. Carlo Perrone Capano to PM. Aldo Moro, April 16, 1975, and Moro to Perrone Capano, May 7, 1975, ACS, PCM, UCD, b. Senegal-TNP, f. TNP documentazione sulla ratifica.

documentation from the CAMEN, in particular, would be crucial to conclude whether there was any truth behind the allegations that the Center was involved in the development of a nuclear test – even if the available sources all seem to deny that such an option was ever considered.[76]

Among the possible explanations which the theoretical literature has advanced to clarify a country's ambiguous feelings toward the NPT, two seem particularly helpful to understand the Italian case. Itty Abraham has argued that given the inescapable dual dimension of nuclear programs, their fundamental ambivalence does not necessarily imply a military objective. To look at them from a proliferation perspective, therefore, is fundamentally misleading and narrows our analytical vision. On the contrary, "nuclear programs are best understood as one of a larger family of public technology projects, not all of which are weapons related or have destructive ends". Resisting any form of outside control, therefore, does not necessarily mean a secret military aspiration, but can be explained as the reluctance to accept a serious limitation to "a claim to a form of national modernity that [states] once took pride in and took for granted".[77] Ariel Levite, on the other hand, has advanced a thesis which may be closer to capturing the essence of what the Italian government was trying to do.[78] Faced with the unpalatable request of adhering to the NPT and accept its restraints, Levite argued, most states do not make a sudden and complete u-turn. Rather, they gradually probe all the possible options to maintain a critical capacity to move quickly from a civilian to a military program. By doing so, they try to explore if the treaty provisions contain any loophole which may allow them to retain (or acquire, if they do not have it yet) as much as possible of the necessary technical knowledge and expertise, as well as the crucial resources in terms of fissionable material and technological infrastructure. Levite defined this attitude as "nuclear hedging", a national strategy lying somewhere in between nuclear pursuit and nuclear rollback.

Levite's paradigm of a hedging state trying to maximize its capacities might go a long way toward explaining the Italian behavior between 1969 and 1975. If one also takes into account Gaja's suggestion that Italy should strive to introduce into the NPT regime a third category of states which have the technological capacity to weaponize but refuse to do so, the Italian initiatives in the field of uranium enrichment, space research and nuclear naval propulsion, as well as the delaying tactics in the ratification of the treaty, may all be seen as an attempt to bolster the country's technological status as much as possible in order to provide policymakers with the broadest possible range of options.

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76 Personal confidential interviews with the author; Vaglini, *Il nucleare a Pisa*.

77 Itty Abraham, "The Ambivalence of Nuclear Histories", *Osiris* 21 (2006): 49-65, see 51 and 65.

78 Ariel E. Levite, "Never Say Never Again: Nuclear Reversal Revisited", *International Security* 27, no. 3 (2002): 59-88.

Matteo Gerlini

Energy Independence vs. Nuclear Safeguards: the US Attitude toward the European Fast Breeder Reactors Program

There is a certain lack of uniformity in the historical knowledge about Italian nuclear programs. This is not only due to the scant number of scholars who have studied the Italian nuclear program, but also to the difficulty in accessing the archival sources needed to carry out this research. Among the programs, those relating to the study and implementation of fast breeder reactors (FBR) were the most outstanding, given that they seemed to offer revolutionary perspectives in the energy field. The development of an FBR on the Apennines between Tuscany and the Emilia Romagna region was undoubtedly one of the most important initiatives in the nuclear sector, and specifically in the Italian nuclear program, due to the economic and technological commitment it entailed. The reactor was called Prova Elementi di Combustibile (PEC), as it was supposed to test the fuel elements that supplied power to the French Superphénix, the European commercial FBR. Although the reactor ceased to function after the 1987 referendum, the papers relating to this experience are still located in Brasimone, in the province of Bologna, in the still active research center of the Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA). The author of this chapter, along with representatives of ENEA, is promoting the establishment of an historical archive of the documents kept in the closed archives of the research center. This chapter is part of a background research on the history of PEC I carried out while working on this historical archive project. It draws on the few existing publications about European FBRs, above all Willy Marth's and Henry Nau's work, and on Antonio Tiseo's research about US President Jimmy Carter's policy relating to the nuclear fuel cycle.[1]

1 Willy Marth, *The Story of the European Fast Reactor Cooperation*, KfK 5255, Kernforschungszentrum Karlsruhe, December (1993); Henry R. Nau, "The Practice of Interdependence in the Research and Development Sector: Fast Reactor Cooperation in Western Europe", *International Organization* 26, no. 3 (1972): 499-526; Antonio Tiseo, "The Carter Administration and its Non-Proliferation policies: the Road to INFCE", *History, Science and Technology*, ed. Matteo Gerlini, special issue of *Humana.Mente* 16, no. 4 (2011): 53-68.

What Are FBRs?

FBRs are reactors that produce their own fuel, and in larger amounts than the fuel needed to support fission.[2] There are two kinds of fuel cycles in FBRs: uranium-plutonium and thorium-uranium. The first one was the cycle that was most developed in the past, due to the military uses of plutonium. In this kind of cycle, the reactor itself produced plutonium with the irradiation of uranium 238, which is the fertile isotope present in the fuel ores and in the blanket fuels of FBRs. The plutonium produced was then separated during the reprocessing of the fuel elements and used as fuel in the reactor.[3] In other words, FBRs are plutonium-fueled reactors that produce their own plutonium from an isotope of uranium otherwise useless for fission, through a reprocessing process.[4] Already in the 1960s, the plutonium and uranium recovery by extraction (PUREX) method for the separation of plutonium produced by the reactor became much more convenient, both technologically and economically.

The thorium-uranium cycle, on the other hand, uses thorium as a fertile element and uranium 233 as a fissile element, in a process that is very similar to the one described for the uranium-plutonium cycle. In both cycles sodium acted as a coolant. However, the thorium-uranium cycle did not lead to the forms of industrial application made possible by the uranium-plutonium cycle, which seemed to promise a revolution in terms of economizing energy sources.[5] FBRs cannot be equated to discovering perpetual motion or eternal fire, but they definitely introduced a new economy in the field of nuclear energy for power production.

FBRs and the Electric Industry

The possibility of creating FBRs first emerged in the early 1950s in Europe. The first liquid metal refrigerated experimental reactor (LMFBR) was built in Douneray, in the Scottish Highlands. The Douneray Fast Reactor (DFR) went critical in 1959 and was connected to the electric grid in 1962.[6] Among the Euratom member states,

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2 Frank von Hippel, "Overview: The Rise and Fall of Plutonium Breeder Reactors", in Thomas B. Cochran et al., *Fast Breeder Reactor Programs: History and Status*, International Panel on Fissile Materials (IPFM) Research Report 8, February 2010: 1-16, http://fissilematerials.org/library/rr08.pdf, last accessed April 12, 2016.

3 Bob van der Zwaan, *L'énergie nucléaire au XXI° siècle: enjeux de sécurité* (Paris: Ifri, 1999).

4 Jeremy Bernstein, *Plutonium: A History of the World's Most Dangerous Element* (Ithaca: Cornell University Press, 2009).

5 Louis Puiseux, *La Babel nucléaire: énergie et développement* (Paris: Galilée, 1977).

6 Walt Patterson, "Fast Breeder Reactors in the United Kingdom", in Cochran et al., *Fast Breeder Reactor Programs*, 73-88.

in 1957-1958 France was the first to plan an experimental fast reactor, RAPSODIE, a merging between "rapide" and "sodie", creating one of the best acronyms in nuclear history. RAPSODIE started working in January 1967, and was successfully connected to the electric grid.[7] Next came Italy and West Germany. In Italy, the RAPTUS program was inaugurated in 1962: the acronym was not the best one (as in Italian *raptus omicida* stands for killing spree), but it stood for "rapid, thorium, uranium, sodium". It involved the building of a fast thermal reactor based on the thorium-uranium cycle, cooled by sodium[8]. In West Germany, the experimental compact sodium-cooled nuclear reactor (KNK I) was built in collaboration with the American industry, and involved the study of sodium technology for the realization of an FBR.[9] The three projects were characterized by a strong relationship with Euratom, setting up association contracts with the agency, with the aim of promoting a common development of applied research in the FBR field. The projects were then affected by a series of tensions that arose between Euratom and member states, and among the member states themselves. Tensions arose gradually, and the study of this process would shed new light on the history of the European community, but its analysis would take us far from the subject of this chapter. Tensions also arose between the governments of the member states due to their relationship with American nuclear programs. In particular, they were a source of concern for France, due to its technological competition with the United States.[10]

The RAPTUS program grew autonomously, but its directors sensibly chose to integrate it into the French FBR project.[11] In the following decade, West Germany established strong relations with the US nuclear complex, whereas the nuclear industry of Belgium and the Netherlands showed similar interests in participating in the programs other member states had started.[12] Due to the success of the DFR, the United Kingdom created a prototype, which in 1966 led the British government to approve the Prototype Fast Reactor (PFR) project.[13] West Germany planned to build a prototype as well, and for this purpose in October 1967 it created the Sodium-cooled Fast Reactor (SNR) consortium along with the Dutch and the Belgians, in order to build the SNR 330 reactor.[14] As Henry Nau has argued, the French had already decided to proceed autonomously not only from Euratom but also from other European partners, as was

7 Mycle Schneider, "Fast Breeder Reactors in France", *Science and Global Security* 17 (2009): 36-53.

8 Mario Silvestri, *Il costo della menzogna. Italia nucleare, 1945-1968* (Torino: Einaudi, 1968).

9 Otto Keck, *Policymaking in a Nuclear Program: The Case of West German Fast Breeder Reactor* (Lexington, MA: Heath, 1981).

10 Nau, "The Practice of Interdependence", 506.

11 Giovanni Paoloni, *Energia, ambiente, innovazione: dal CNRN all'ENEA* (Roma-Bari: Laterza, 1992).

12 Nau, "The Practice of Interdependence", 513-14.

13 Patterson, "Fast Breeder Reactors".

14 Marth, *The Story*, 25-26.

clear during the negotiations with Italy in the fall of 1965.[15] The Italians wanted to join the French program and build the PEC in Brasimone, which would bring the common project directly to its commercial phase, since RAPSODIE would cover the prototypical phase.[16] The French, however, thought that a prototypical phase was still needed, and the PEC would have become useful only in the business phase.[17] In 1967, when RAPSODIE went critical, the French government decided to build a prototype called Phénix, using the name of the mythical bird that rose from its ashes, an appropriate metaphor for the FBR.[18] Leaving aside the British project, which had developed autonomously from the European partners, it was obvious that in the Euratom environment the prototypical phase showed at least two duplications, and risked a third one if the PEC was to be started as a prototype. In September 1969, in a resolution published in the Italian journal *Atomo e industria*, the final users of the FBR, namely the electricity producers gathering around the Union internationale des Producteurs et Distributeurs d'Énergie Électrique (UNIPEDE),[19] complained about the waste of resources that was occurring in Europe in the development of FBRs, and asked to combine efforts in order to create a single 1,000 MWe trading model.[20] Two months later, the European Council met in The Hague and argued for the need of the "widest possible cooperation" in the field of FBRs, but it was only in late December 1973 that Electricité de France (EDF), the Ente Nazionale per l'Energia Elettrica (ENEL) and the Rheinisch-Westfälisches Elektrizitätswerk (RWE) signed the so-called "utilities convention".[21] The three producers finally agreed to coordinate their efforts, although the agreement they signed provided for the building of three trading reactors, which followed two different kinds of cooling systems: the first to be built would be a pool type, the second a loop type.[22] The pool type Superphénix would be built in France, followed by the loop type SNR 2 in Germany.[23] In April 1976, the French President Giscard d'Estaing approved the project and, in 1977, work started on the site of Creys-Malville.[24] Italy had a 33 per cent share of the

15 Nau,"The Practice of Interdependence", 515.

16 Paoloni, *Energia, ambiente, innovazione*, 104-05.

17 Nau, ""The Practice of Interdependence", 515-16.

18 Jean-François Sauvage, *Phénix, une histoire de cœur et d'énergie* (Bagnols-sur-Cèze: CEA-EDF, 2004).

19 On UNIPEDE history see Vincent Christiaan Lagendijk, *Electrifying Europe: The Power of Europe in the Construction of Electricity Networks* (Amsterdam: Aksant, 2008).

20 *Atomo e industria*, November 1969.

21 Nau, "The Practice of Interdependence", 518.

22 *Survey of the Nuclear Policy of the European Communities*, Supplement to the *Bulletin of the European Communities*, September-October 1968, qt. in Nau, "The practice of interdependence", 518.

23 Marth, *The Story*, 21-25.

24 Claude Bienvenu, *Superphénix: le nucléaire à la française* (Paris-Montréal: l'Harmattan, 1999).

two companies managing the SNR 2 and the Superphénix, and participated in the PEC reactor project, which tested the fuel elements of the Superphénix.[25]

Jimmy Carter's Worries

That same year, Jimmy Carter became President of the United States, an event that indirectly influenced – with interesting historical implications – the fate of FBRs, not only in Europe. As Tiseo has argued, in talking about nuclear issues President Carter relied on his knowledge about nuclear engineering and on his personal attitude toward the energy question.[26] Generally speaking, ever since his campaign against Gerald Ford, Carter was cautious about promoting the production of electric power from a nuclear source. This was clear during the Conference on Nuclear Energy and World Order held on May 13, 1976, when the democratic candidate spoke in favor of renewable energy sources. It would not be correct to define Carter's attitude as the expression of a green opposition to nuclear power. His actions were the outcome of the unavoidable intertwining between civilian applications of nuclear energy and potential military uses. Following the spirit of the Non-Proliferation Treaty (NPT), Carter claimed that contracting countries that did not possess nuclear arms should be granted special conditions in the technological transfer from providing countries, but the possibility that such countries could leave the regime provided by the treaty should be prevented.[27]

The aspect of Carter's position that is most relevant for us concerns the sale of reprocessing technology. According to Carter, the assignment of technology should have been discouraged, and the United States should have committed itself to making sure that supplying countries would not invade this field, in the pursuit of their business interests, as this would endanger the strengthening of nonproliferation.[28]

Reprocessing was an integral part of the possible marketing of FBRs. These reactors were also crucial for technological developments of the US nuclear sector: in 1976, work to create the first liquid metal fast breeder reactor (LMFBR) in Clinch River, Tennessee, started, creating a model that other plants would soon follow.[29] May be even more

25 Marth, *The Story*,14.

26 Tiseo, "The Carter Administration".

27 Speech by Gov. Jimmy Carter at *Conference on Nuclear Energy and World Order*, May 13, 1976 qt. in "Nuclear Issues in the Presidential Campaign: Three Steps Toward Nuclear Responsibility", *Bulletin of the Atomic Scientists*, October 1976: 8-14.

28 Speech by Gov. Jimmy Carter.

29 *Memorandum to the President from Charles Warren on Clinch River Breeder Reactor and re processing policy*, April 13, 1977, Jimmy Carter Library Donated Historical Material, White House Central File – Subject File, National Security – Defense – ND-18. box ND-48: General ND 16/CO 172 1/20/77 through Executive.

keenly than their European colleagues, the directors of US nuclear plants wanted to shift from the slow-neutron thermal reactors to FBRs. Therefore, fuel reprocessing was crucial to the US nuclear industry. The newly created Department of Energy (DOE) immediately favored FBRs and the plan to develop the LMFBR, while the Department of Defense immediately detected the potential proliferation risks embedded in that technology.

On March 24, 1977 Carter issued the Presidential Directive/NSC-8, the cornerstone of his Non-Proliferation Policy, completely disregarding the expectations of FBR supporters. As he stated:

> It shall be a principal US security objective to prevent the spread of nuclear explosive, or near explosive, capabilities to countries that do not now possess them. To this end US non-proliferation policy shall be directed at preventing the development and use of sensitive nuclear power technologies which involve direct access to plutonium, highly enriched uranium or other weapon usable materials in non-nuclear weapons states, and at minimizing the global accumulation of these materials.[30]

FBRs were part and parcel of the Presidential Directive's objectives. To achieve them, the US government committed to "indefinitely defer the commercial reprocessing and recycle of plutonium in the US", meaning that it would "restructure the US breeder program so as to emphasize alternative design to the plutonium breeder, and to meet a later date for possible commercialization".[31] Given that these aims had to be accepted worldwide, the US government proposed that countries using nuclear energy follow a common path, and pursue a common research project for the development of alternative technologies to those used in FBRs.

The US nuclear industry could protest but had to abide by the Carter's rules. The reaction of European nuclear industries and governments, though, was much sharper, given that reprocessing represented a large part of the European nuclear market, and that France, West Germany and the United Kingdom had signed important agreements with countries such as Switzerland, Sweden and Japan. They were hoping to sell the FBRs they had worked on together, but if PUREX could not be sold, FBRs lost their meaning.

Already in July 1977, after the National Security Council (NSC) and the Central Intelligence Agency (CIA) received news of European reactions, Carter moderated the peremptoriness of the Presidential Directive, stating: "we are not trying to impose our

30 *Presidential Directive/NSC-8, to the Vice President, the Secretary of State and Defense and others. On Nuclear non-proliferation policy*, March 24, 1977, http://fas.org/irp/offdocs/pd/pd08.pdf, last accessed April 12, 2016.

31 *Presidential Directive/NSC-8*.

will on those nations like Japan, France, Britain and Germany, which already have reprocessing plants in operation".[32]

While it seemed like Carter was opening up to European nuclear industries, he was in fact becoming more rigid toward the US industry, which was investing in FBRs, and kept a firm position on the Clinch River reactor. From a historical point of view, it is important to analyze how the US nuclear industry's abandonment of FBRs might have influenced the development of this technology worldwide. Perhaps, Carter thought that a bird in the hand is worth two in the bush: while the US government did not question the outcome of the international agreements signed by West European countries, Europeans accepted the US President's basic criterion, and participated in the International Nuclear Fuel Cycle Evaluation (INFCE), which will be examined later in the chapter. Most importantly, by giving up research in such frontier technology as FBRs, the American nuclear complex marked a turning point in the commercialization of FBRs. Europeans proved to be successful in the prototype phase, but the commercial phase still needed applied research. Without the seminal contribution of American nuclear complex, the process was seriously jeopardized. Eventually, Europeans were alone facing the various technical problems of large-scale, power FBRs. In fact, one of the worst technical problems encountered by Superphénix was the wearing of materials undergoing the neutron flow, and the chemical problems caused by sodium cooling, given that sodium is pyrophoric and explosive with water contact.

The Effects of US Nuclear Choices

The US nuclear complex[33] was crucial for the Western bloc's nuclear industry, as was clear during the temporary stop in the delivery of nuclear fuel from the United States to Europe in July 1976, in the last months of Gerald Ford's presidency. While the fuel was ready to be shipped, the US President discontinued the delivery, waiting for Congress' decision on the non-proliferation directive.[34]

Almost all European countries were opposed to the Presidential decision to keep the

32 Jimmy Carter, "Nuclear Power Policy, Statement on decisions reached following a review, April 7, 1977", *Public Papers of the President of the United States Jimmy Carter 1977-1981*, Book 1, January 20 to June 24, 1977 (Washington: Office of the Federal Register, National Archives and Record Service, General Service Administration, 1977).

33 For the concept of "nuclear complex" see the homonymous Bertrand Goldschmidt, *Le complexe atomique. Histoire politique de l'énergie nucléaire* (Paris: Fayard 1980).

34 Steven J. Baker, "Monopoly or Cartel?", *Foreign Policy* 23 (Summer 1976): 155-201; Philip Gummett, "Development in Thinking about Nuclear Non-Proliferation", *International Affairs* 57, no. 4 (Autumn 1981): 553.

block on nuclear materials: France and Germany had the harshest reactions. In March 1977, a CIA report on the aspects relating to the FBRs fuel addressed the issue, arguing that the European community's attempts to formulate an energy policy had been frustrated. According to the Agency, this was largely due to the unwillingness on the part of member countries, especially France, to surrender the decision-making authority in order to allow for effective planning. Nevertheless, the report noted, at the height of 1977 France came to realize that further cooperation was needed, although arm's length involvement seemed to be a distinct preference:

> One of the most fruitful areas for mutual cooperation is nuclear reprocessing. This is where the French have focused their efforts and will have the most to offer. The French recognize that there are technological benefits to be gained from cooperation in the field of fast breeder reactors, but they apparently are hesitant to make their operating experience to any country without obtaining commercial benefits. France probably seeks to license foreign groups to use the technologies.[35]

Already in October 1977, Carter promoted an alternative research in FBRs, based on the thorium-uranium cycle, which barred the production of plutonium and therefore the risk of proliferation. From a political and financial point of view, this meant that all efforts made in the research on plutonium would be notably depreciated. This was not an attractive perspective for Europe, although its various member states could count on American help.

Whether Europe liked it or not, control over fuel and technology were the main tools the US government used to strengthen the Non-Proliferation Treaty (NPT) regime. As Joseph Nye has argued,[36] this technical approach became evident with the approval on March 10, 1978 of the Nuclear Non-proliferation Act[37]; the Act set the criteria according to which nuclear materials could be exported, and forbid their sale to any country

35 *Scientific and Technical Intelligence Report. Subject: French Policy and Plans for Energy R&D,* Central Intelligence Agency Top Secret Report to the President, March 1977, obtained by Freedom of Information Act (hereafter FOIA) from the National Security Archive Foundation of Washington DC, Collection: nuclear non-proliferation, number 00198, 23 pages. Alleged: *Scientific and Technical Intelligence Report. Subject: French Nuclear Power and Plans for Energy R&D,* Central Intelligence Agency Top Secret Report to the President, September 1976, obtained by FOIA from the National Security Archive Foundation of Washington DC, Collection: nuclear non-proliferation, number 00191, 20 pages.

36 Joseph S. Nye, "Non-proliferation: A Long Term Strategy", *Foreign Affairs* 56, no. 3 (April 1978): 601-23.

37 Warren H. Donnelly, "Application of US Non-proliferation Legislation for Technical Aspects of Fissionable Materials in Non-military Applications", in Stockholm International Peace Research Institute, *Nuclear Energy and Nuclear Weapons Proliferation* (London-New York: Taylor and Francis, 1979).

that did not accept the international safeguards provisions on plants' safety and suitability set forth by the International Atomic Energy Agency (IAEA).[38]

The End of FBRs

The INFCE, strongly supported by Carter to promote an alternative to uranium reprocessing and enrichment, partly became the sounding board for tensions that emerged in the relationship between the United States and the other participating countries. The INFCE held its first organizational conference in October 1977, and closed in 1980 with a final declaration, which included statements from individual national delegations. According to Bertrand Goldschmidt, a prominent person in the French nuclear program, the INFCE was "a technical-diplomatic compromise in a sort of giant scientific happening",[39] according to Nye, "while officially INFCE was given a predominantly technical rationale, this was a means of attracting broad participation into what was really part of a political process of stabilizing the basis for the international regime".[40] It was difficult to deny the importance of INFCE in furthering and consolidating the creation of a binding regime against nuclear proliferation.[41]

In this frame, it became harder for FBRs to be successful commercially. After a series of protests and attacks, Superphénix, which was connected to the electric grid in 1986, underwent several accidents. It was transformed into a research reactor in 1994, and finally switched off in 1998, after a short but troubled existence. The PEC was almost completed but it remained unfinished until after the 1987 Italian referendum on nuclear power, and was eventually dismantled. The SNR 2, on the other hand, was never built. Not even the British nuclear program, the first ever to be carried out, succeeded in convincing its government to invest in FBRs. Therefore, FBRs as a competitive technological option for electric power, were in a tight spot. The historical reconstruction of the Italian project ends here, with the scant images we have reported so far.

Having access to the historical archive of the PEC program in the future is crucial to carry out research on this experience and on the history of the Italian FBR program. How did the managers of the Italian project face the crisis, and what was the institutional activity of the persons involved in FBRs before the United States advanced its position

38 It occurred with the Pakistani site of Kahuta Khan. Feroz Hassan, *Eating Grass: The Making of the Pakistani Bomb* (Palo Alto: Stanford University Press, 2012).

39 Goldschmidt, *Le Complexe atomique*, 489.

40 Joseph S. Nye, "Sustaining Non-Proliferation in the 1980s", *Survival* 23, no. 3 (May-June 1981): 101.

41 Jayantha Dhanapala, "The management of NPT Diplomacy", *Daedalus* 139, no. 1 (Winter 2010): 57-67.

on FBRs? This is one of the most interesting questions that, hopefully, scholars will be able to answer in the future. The techno-political conjunctions of that historical period were critical for the international nuclear industry, as well as for the development of the nuclear dual-use and its strategic implications.

Carter did not interrupt the worldwide production of separated plutonium, but he certainly discouraged it and greatly reduced it. One of the initiatives US President Barack Obama promoted, which future historians will probably discuss, is the nuclear security summit process, facing the problem of the minimization of the currently outstanding separated plutonium, a process Carter started in 1977 from a more realistic and current point of view.

Marilena Gala

Italy's Role in the Implementation of the Dual-Track Decision

Italy became a crucial participant in the implementation of the dual-track decision at the Guadeloupe summit, the meeting held by the American, British, French, and German leaders between 5 and 7 January, 1979. It was a paradoxical result to some extent, in as much as Rome had been patently excluded from the consultations and the bilateral talks which had occurred in the previous years especially between Bonn, London, Washington and even Paris. Italy's relatively marginal position was determined by different factors; one of them – namely, its status of non-nuclear weapon state – was bound to turn into a source of political relevance within North Atlantic Treaty Organization (NATO) over the next decade. The main purpose of this chapter is to highlight to what extent such a status helped Rome to enhance its stance as an Atlantic partner, once Italy committed itself to deploy theatre nuclear systems of the new-generation.

The idea of a quadripartite summit was put forward by US President Jimmy Carter, who, during the Fall of 1978, was becoming increasingly worried about the faltering NATO cohesion, deeply affected by what in most European countries was perceived as the US lack of leadership.[1] The West German government, in particular, lamented a dangerous mismanagement of the process of modernization of the Alliance's military capabilities that had reached its peak with the neutron bomb affair.[2] The related discus-

1 Memorandum for the President from Zbigniew Brzezinski, Jimmy Carter Library, Atlanta, Georgia, USA (hereafter JCL), digital collection, NLC 128-9-15-12-1, subject: My meetings with President Giscard, Chancellor Schmidt and Prime Minister Callaghan, October 4, 1978; Record of a conversation between the Prime Minister and Dr. Z. Brzezinski in the Imperial Hotel, on Wednesday October 4 at 10:00 hours, The National Archives, Kew, Richmond, Surrey, UK (hereafter TNA), PREM 16/1984.

2 On the heated debate which soon developed in NATO, and in West Germany in particular about the neutron bomb possible deployment, see: Kristina Spohr Readman, "Germany and the Politics of the Neutron Bomb, 1975-1979", *Diplomacy & Statecraft* 21, no. 2 (June 2010): 259-85; Jimmy Carter, *Keeping Faith* (Fayetteville: University of Arkansas Press, 1995), 231-34; Zbigniew Brzezinski, *Power and Principle: Memoirs of the National Security Advisor, 1977-1981* (New York: Straus & Giroux, 1983), 301-06; Helmut Schmidt, *Menschen und Mächte* (Berlin: Siedler, 1987), 222-29.

sions developed among NATO partners had emphasized that there was not yet a coincidence of intentions, as the key allies were concerned, in somewhat different ways, about the consequences of the growing disparities in long-range theater capabilities between the Soviet bloc and the Western alliance in Europe.[3] Those disparities were progressively perceived as the source of a further risk of decoupling between West European defense and the US strategic capabilities, whose credibility was already under scrutiny because of the tenet of essential equivalence implicitly affirmed through the negotiating process concerning the strategic arsenals of the two superpowers.[4]

On the Caribbean island, therefore, the American President tried to obtain a clear indication of European allies' willingness to accept either the neutron weapons, the ground launched cruise missiles (GLCM), or the Pershing II, which might help to meet the SS-20 and backfire aircraft threats. According to Carter, if the next round of negotiations with the Soviets on Strategic Arms Limitation Talks (SALT) III had to include limitations of theatre nuclear forces (TNF) in Europe, the alliance had to show its determination to deploy medium range missiles.[5] Such a determination was expected inter alia from Bonn, whose participation in the modernization program was definitely crucial. At the Guadeloupe summit, the German chancellor eventually acceded but pointed out that he would "take GLCMs on German soil provided at least one other European NATO ally did the same".[6] That was the so-called "non-singularity" clause, a condition West Germany had urged would be met no matter what nuclear modernization process NATO was carrying out.[7] Then, after the January 1979 summit, the West German consent to host, on its territory, new theatre systems was refined with a further requirement: the deployment had to involve other non-nuclear countries, which meant that the expected modernization of the United Kingdom deterrent was not considered as complying, while Belgium and the Netherlands were mentioned as natural candidates for the developing Alliance plans.[8]

3 Memorandum for Z. Brzezinski, JCL, digital collection, NLC 132-49-5-1-5, subject: Alliance consultations on Theater Nuclear Issues, October 17, 1978; Ministerialdirektor Blich, z. Z. Washington, an das Auswärtige Amt, October 12, 1978, Akten zur Auswärtigen Politik der Bundesrepublik Deutschland, Das Institut für Zeitgeschichte, Berlin, Germany (hereafter AAPD), Vol. II, 1978.

4 Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 342-54.

5 President Jimmy Carter's personal brief notes on the Guadeloupe summit meeting, January 12, 1979, JCL, digital collection, NLC 128-4-12-3-9.

6 Gespräch des Bundeskanzlers Schmidt mit Premierminister Callaghan, Präsident Carter und Staatspräsident Giscard d'Estaing auf Guadeloupe, January 5, 1979, AAPD, Vol. I, 1979.

7 Gespräch des Staatssekretärs van Well mit dem stellvertretenden Sicherheitsberater des amerikanischen Präsidenten, Aaron, January 30, 1978, AAPD, Vol. I, 1978.

8 Brief from the Secretary of the Cabinet on Grey Areas, March 8, 1979, TNA, PREM 16/1984.

If these were the conditions urged by Bonn, the White House was now unquestionably supporting NATO modernization in Europe and, with that goal in mind, was trying to get a clear commitment on the part of its Atlantic partners. The government in Rome, after having voiced its indignation for its exclusion from the quadripartite summit,[9] was involved in a series of bilateral consultations first with its American counterpart. David Aaron, the US Deputy National Security Advisor, went to Italy first in March 1979. At that time, however, the Italian domestic scene seemed to imply at least a troubled participation of the country to the TNF deployment.[10] The strong Partito Comunista Italiano (PCI), which eventually had accepted Italy's Western alignment, was expected to resist any decision envisaging an Italian involvement in the expansion of NATO's nuclear deterrent, inevitably bound to renew Cold War tensions with the Soviets.[11] Yet, the elections of June 1979 turned out to be critical to significantly reduce the role the PCI had played during the years of the *compromesso storico* (the so-called historic compromise), when the Communists' implicit support in Parliament had been crucial in keeping the Cristian Democrats (DC) in control of the executive power. Now it had become possible to set up a government that could dismiss such an indirect support, anticipating to some extent the *pentapartito* (five party) formula of the mid-1980s.[12]

In July, at the time of Aaron's second trip to Rome, the outgoing Prime Minister Giulio Andreotti simply acknowledged the United States' invitation to concretely participate in the decision-making process leading to the modernization of NATO's nuclear deterrent.[13] But at the same time, a more explicit request was addressed to Italy by Chancellor Helmut Schmidt, the German leader. During a meeting in Rome with the Italian President of the Republic, Sandro Pertini, Schmidt openly solicited the Italian commitment to future TNF deployments.[14] West Germany's obsession with the "non-singularity" clause could not remain neglected as the time for decision was approaching with the critical North Atlantic Council already scheduled for December 1979. By that Fall, first the Netherlands, and consequently Belgium, had ceased to ap-

9 Elementi del colloquio del 17 marzo 1979 fra il Ministro degli Esteri Forlani e il Vice Direttore del NSC, David Aaron, per la parte relativa al 'modus procedendi' delle consultazioni fra gli alleati ed all'incontro della Guadalupa, Archivio Andreotti, Istituto Luigi Sturzo, Roma, Italy (hereafter AAn), busta 595, David Aaron, Ministero degli Affari Esteri, Direzione Generale degli Affari Politici.

10 Leopoldo Nuti, "The Nuclear Debate in Italian Politics in the Late 1970s and the Early 1980s", in *The Euromissile Crisis and the End of the Cold War*, ed. Leopoldo Nuti, Frédéric Bozo, Marie-Pierre Rey, and Bernd Rother (Washington DC: The Woodrow Wilson Center Press, 2015), 231-50.

11 Lelio Lagorio, *L'ultima sfida – gli euromissili* (Firenze: Loggia dei Lanzi, 1998), 13-17.

12 Nuti, "The Nuclear Debate", 235-38.

13 Incontro dell'On. Presidente del Consiglio con il Sig. David Aaron, Consigliere aggiunto del Presidente Carter per gli affari di sicurezza nazionale – Palazzo Chigi, July 19, 1979, AAn, busta 595, David Aaron, Consigliere Diplomatico del Presidente del Consiglio dei Ministri.

14 Lagorio, *L'ultima sfida*, 28-29.

pear as sure bets for sharing with Bonn the responsibility of increasing NATO's nuclear deterrent capabilities in Europe, according to the plan formulated by the High Level Group (HLG). In spite of the political maneuvers and the diplomatic efforts invested in the attempt to finally find a compromise on a program that established deploying 572 long-range theatre nuclear missiles (cruise and Pershing II), the Dutch government stepped back questioning the numbers that had been so difficult to agree in the previous months.[15] Conversely – and rather unexpectedly – Italy revealed a much firmer stance. Regardless of the foreseeable difficulty in gaining the support of national public opinion, the head of the new government, Francesco Cossiga, ended up embracing the idea of the TNF deployment. The concurrence eventually expressed by the leadership of the Partito Socialista Italiano (PSI) was critical to win his initial caution on that issue. In fact, once, by the end of October, the PSI leadership had made up their mind and agreed that a dual approach, combining deployment and arms control was viable,[16] the Italian Cabinet gave its assent, committing the country to the modernization plans.[17] With Italy's consent the dual-track decision could be definitely adopted, in December 1979, by the North Atlantic Council, whose members had a few years to devote to negotiations before a regional nuclear build-up would be necessarily implemented.[18]

The Italian government, aware of the increased responsibility of being one of the few certain deploying countries, and of the politically relevant opportunities provided by closer cooperation with its NATO partners, immediately pursued a deeper coordination with Bonn, which responded in kind. In a letter sent by the German Chancellor to Cossiga at the end of January 1980, the former confirmed his opinion that, to be considered – or implemented, for that matter – any review of the NATO modernization program already decided by the Alliance needed to be offset by real results in terms of arms control. Therefore, a firm stance on the part of the Atlantic allies was a priority that both Italy and West Germany agreed would require a coordinated action aiming

15 Gespräch des Bundesministers Genscher mit dem britischen Aussenminister Carrington, October 31, 1979, AAPD, Vol. II, 1979. The Dutch political scene was so divided on the issue of NATO modernization that, on December 6, the Netherlands Parliament voted by seventy-six votes to sixty-nine in favor of a motion rejecting not only basing in the Netherlands but also Dutch support for a modernization program of any kind.

16 Mozione signed by: Craxi, Balzamo, Signorile, Lagorio, Manca, Archivio Centrale dello Stato, Roma, Italy (hereafter ACS), Serie 15 (Consigliere Diplomatico della Presidenza del Consiglio), NATO 5/2, Camera dei Deputati, Gruppo Parlamentare del PSI.

17 Nuti, "The Nuclear Debate", 237-38; see also Lagorio, *L'ultima sfida*, 30-38.

18 The final communiqué of the NATO Special Foreign and Defense Ministers meeting is available on the page: www.nato.int/docu/basictxt/b791212a/htm, last accessed February 18, 2016.

at bringing "also Belgium to overcome its previous reservations toward the stationing of the missiles".[19]

The Soviet reaction to the dual-track decision and the subsequent North Atlantic Council (NAC) Communiqué, that in mid-December 1979 advanced the Atlantic alliance offer to start TNF negotiations, was utterly negative. Moscow basically responded that no negotiations would be opened unless NATO countries overtly renounced their modernization program. Indeed, the Kremlin's uncompromising stance arose from the ill-founded conviction that, again, as had happened at the time of the neutron bomb debate, it would be enough for the Soviet Union to fan the flames of European citizens' fears for mobilizing a large majority of Western public opinion against the new plans for the deployment of intermediate-range nuclear forces (INF) on the other side of the Iron curtain.[20]

All in all, in the early days of 1980, arms control appeared to be founded on rather shaky bases. The Soviet Union had invaded Afghanistan and consequently the ratification of SALT II by the US Congress was doomed, as well as what still remained of détente between the two superpowers. Indeed, there was no immediate prospect of SALT III negotiations and no obvious forum for TNF arms control discussions. Rather, the Soviets had rejected the US offer to open talks on theatre nuclear systems and were seemingly in favor of enhancing their ultimate negotiating position by continuing their SS-20 deployments. For the Western Alliance, however, the US arms control offer had to remain on the table and NATO had to proceed with the preparation of its position for negotiations. To pursue that goal, the Carter administration was working in particular with the United Kingdom, West Germany and Italy to establish, within the NATO framework, the High-level Special Consultative Group (SCG). The rationale of confirming, after the results achieved with the Special Group in 1979,[21] a consultation

19 Letter from Helmut Schmidt to Francesco Cossiga, January 28, 1980, ACS, Serie 15, NATO 5/1. Both the two leaders took very seriously the reservations expressed by Belgium and the Netherlands at the December 1979 NAC meeting and agreed to "start first with Belgium, that by the end of June is expected to decide about the completion of the program".

20 Maynard W. Glitman, *The Last Battle of the Cold War: An Inside Account of Negotiating the Intermediate Range Nuclear Forces Treaty* (New York: Palgrave Macmillan, 2006), 46-48. For a detailed account on the role played by the Soviets in mobilizing Western European public opinion against any deployment decision, see: Jeffrey Herf, *War by Other Means: Soviet Power, West German Resistance, and the Battle of the Euromissiles* (New York: Free Press, 1991).

21 The so-called Special Group had been set up in April 1979, on the principle that modernization and arms control goals had to reinforce one another. West Germany acted as front runner to establish such a group whose main purpose was to formulate objectives and principles related to any arms control negotiations involving theatre nuclear systems; still, its creation followed intensive US-UK-FGR consultations, see: Marilena Gala, "NATO Modernization at the Time of Détente: a Test of European Coming of Age?", *Historische Mitteilungen* 24 (2011): 115-18.

process across the Atlantic arose from the awareness, shared in Washington and West European capitals, that "SALT III negotiations involving TNF will include issues which have an especially direct and substantial impact on the security of the Alliance". The group would receive its mandate from the NAC and would consist of high-level officials from NATO governments, while its spelled out purpose was to allow the United States to "consult with its allies on the approach to be taken by the US on arms control issues involving LRTNF [long-range theatre nuclear forces] in SALT III, based on the objectives and principles approved by Ministers on December 12, 1979".[22]

In spite of the advisory mechanism created for the sake of NATO cohesion, over the next half of the year, the prospects of re-launching arms control negotiations remained definitely poor. Only in June 1980, during a meeting with Chancellor Schmidt, Leonid Brezhnev finally indicated Soviet willingness to enter into exchanges on INF without preconditions.[23] As a result, the US Secretary of State, Edmund Muskie, met with Soviet Foreign Minister, Andrej Gromyko, and agreed to begin talks. Then, in Geneva, the heads of the two superpowers' delegations met on October 17 to start the first round of negotiations that lasted for the next month. The two parties exposed the main elements of their respective negotiating approaches. From an American perspective, Moscow was "putting forth a proposal which would codify the Soviet monopoly in long-range land-based theater nuclear missiles, and indeed allow their build-up of SS-20s … to continue". Clearly, the "Soviets' primary objective" remained to block the NATO modernization program. Nonetheless, "despite the not unexpected differences in approach", the same report concluded, "the Geneva meetings constituted a constructive first step in arms control involving TNF. They were serious and substantive with each side playing out major elements of its approach".[24] At the conclusion of this preliminary round a date for resumption of the talks in the next year had still to be set through mutual Soviet-American consultation. This could possibly have been one of the first issues on the agenda of the outgoing administration, if it were re-elected. Instead, the Republican candidate, Ronald Reagan, won the elections and became the new President of the United States.

At the White House, now, there was a leader who openly rejected the concept of détente both on political and moral bases. With détente, he also opposed the arms con-

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22 Telegram from SecState Washington to AmEmbassies Bonn, London, Rome, and USmission USNATO, January 5, 1980, TNA, FCO 46/2373, subject: TNF: proposed TOR for Special Consultative Group.

23 Glitman, *The Last Battle of the Cold War*, 48.

24 Telegram from SecState Washington to AmEmbassy London, received on November 19, 1979, TNA, FCO 46/2373, subject: TNF: Draft of Second SCG Progress Report to Ministers.

trol process carried out throughout the 1970s, which had led to the SALT agreements.[25] Conversely, for Europeans détente was still of critical importance. As the Italian Foreign Minister Franco Maria Malfatti had declared, on October 31, 1979, during the parliamentary debate about the government's assessment on the problems of security and disarmament, "détente is and must remain the essential goal of Italian foreign policy".[26] In other words, for the American NATO allies the decision taken in December 1979 had to be implemented not just in terms of nuclear build-up but also – if not especially – in terms of negotiations to dismantle the arsenals targeted against European countries.

A few weeks after the official settlement of the Reagan administration, the new head of the Farnesina, Emilio Colombo, was in Washington to meet with some of the administration's most important members, including the President. To Secretary of State Alexander Haig the Italian Foreign Minister clearly said that his country "had made a commitment to TNF modernization but it was necessary to comply with the second part of the [dual-track] decision". Haig concurred and acknowledged the need for consultations "especially with those allies directly concerned in the TNF modernization decision". Yet, he also pointed out that for President Reagan and himself, "to proceed with the Russians along the track of 'functional dialogue' … without an assurance that the Russians intended to respect a certain line of conduct in international affairs would be against the interests of the United States and of the West".[27]

Indeed, Italy, the United Kingdom and West Germany did intend to keep their word and remain committed to TNF deployments. Those European governments had even worked on a paper focused on general concepts and criteria to be used in the next steps of NATO discussions in order "to maintain the momentum of the HLG during the post-election period in the US".[28] Yet, they could not easily align to the attempt to introduce the linkage approach that the new US government was advocating. As Colombo underlined to his American counterpart, before making policy announcements, the Reagan administration had "to take account of repercussions in Europe and

25 Sean Wilentz, *The Age of Reagan: A History, 1974-2008* (New York: HarperCollins Publishers, 2008). Chaps. V and VI. On Reagan's security and arms control policies, see: Chester J. Jr. Pach, "Sticking to His Guns: Reagan and National Security", in *The Reagan Presidency: Pragmatic Conservatism & Its Legacies*, ed. Elliot W. Brownlee and Hugh Davis Graham (Lawrence: University Press of Kansas, 2003), 85-112; Ronald E. Powaski, *Return to Armageddon: The United States and the Nuclear Arms Race, 1981-1999* (New York: Oxford University Press, 2000), 14-16.

26 Risposta dell'On. Ministro alle interrogazioni ed interpellanze, Camera dei Deputati, October 31, 1979, ACS, Serie 15, NATO 5/2.

27 Telegram from Washington to FCO, February 13, 1981, TNA, FCO 46/2759, TNF: visit of Foreign Minister Colombo.

28 From the Ministry of Defense to British Embassy, Washington, February 6, 1981, NPG (Nuclear Planning Group) High Level Group – Paper by UK, FRG and Italy, TNA, FCO 46/2718.

to consult with the Europeans beforehand".[29] The quest for transatlantic cooperation was at the center of the talks between the West German and Italian Foreign Ministers in mid-March 1981. Both Hans-Dietrich Genscher and Colombo agreed that the European allies had to work together and in close collaboration with Washington to resist the Soviet propaganda campaign aimed at creating a cleavage between the two sides of the Atlantic. They also confirmed the common commitment to the modernization program, whose wavering could be prevented only if Bonn and Rome managed to proceed together.[30] Such a determination had been reasserted to the US President by West Germany Foreign Minister a week earlier. On this occasion, the European leader had openly praised the Italian government for "being at least as firm as Germany, in spite of the more difficult domestic situation it had to deal with", and announced its intention to try to convince "also their other European friends" whose commitment to the modernization program had been postponed or openly rejected.[31]

In order to be continued in the medium term, the firmness displayed in Rome and Bonn toward the nuclear build-up track of the December 1979 decision needed to be boosted by combining with negotiations. Instead, since the first months of his term, the US President had patently refrained from embracing the dual-track decision inherited by the previous administration. Only at the North Atlantic Council held in Rome in early May 1981, did the White House eventually accede and, together with the other NATO countries, "reaffirm their commitment to that [dual-track] decision".[32] Still, the impression prevailing in the European capitals was that the Americans would seek to give priority to the modernization process and therefore to establish full Department of Defense influence over the TNF negotiations with the Soviets, which, according to the US representative to the HLG, were due to begin in the next Autumn.[33]

The American government had undertaken a thorough review of the US arms control policy and in mid-1981 was still striving to formulate a set of proposals that would reconcile its wary approach toward the Soviets with the need to commit, before the world, to reducing the risk of a nuclear holocaust. While its NATO partners lamented

29 Telegram from Washington to FCO, February 13, 1981, NPG (Nuclear Planning Group) High Level Group – Paper by UK, FRG and Italy, TNA, FCO 46/2759.

30 Gespräch des Bundesministers Genscher mit dem italienischen Aussenminister Colombo, March 17, 1981, AAPD, Vol. I, 1981.

31 Gespräch des Bundesministers Genscher mit dem Präsident Reagan in Washington, March 9, 1981, AAPD, Vol. I, 1981.

32 Telegram from Rome, May 5, 1981, Ronald Reagan Presidential Library, Simi Valley, California, USA (hereafter RRPL), Sven Kraemer Files, box 91316, NATO HLG.

33 Note from David H. Gillmore, May 15, 1981, HLG Meeting: Brussels, May 13-14, TNA, FCO 46/2719; Note from the UK Delegation to NATO, July 1, 1981, Public Presentation of Nuclear Issues: HLG Follow-up, FCO 46/2756.

the lack of a real multilateral dimension in the arms control policy pursued in Washington – and even in London a negative assessment seemed to prevail about the "bipolar US vision of the world"[34] – for the State Department the time had come "to argue more aggressively particularly on TNF" and "to turn around a largely defensive and responsive Western posture". In shaping the Western proposals, the United States and its NATO allies had to keep in mind that "'negotiability' considerations should take a back seat to public impact".[35] With the beginning of negotiations in Geneva approaching, European partners seemed to agree. In fact, at the Nuclear Planning Group (NPG) ministerial meeting held before the opening of the American-Soviet talks – expected to take place between mid-November and mid-December 1981 – most of NATO's Defense Ministers showed a deeper awareness toward the so-called "public presentation matter". In particular, the zero option was mentioned and discussed at some length. Such a formula had been circulating among NATO countries at least since October 1979, when in West Germany, the Netherlands, and Italy the need to assuage national growing concerns about the future of détente and arms control had prompted their government majorities to hint that for the modernization option "a zero deployment possibility [if the Soviets eliminate LRTNF]"[36] existed. At the end of October 1981, this hypothesis was supported again on the principle – spelled out by the Norwegian Minister – that "although prospects for reciprocal zero option were not good, it was important to keep the option open", and leave the onus of its possible rejection to the Soviet Union.[37] Indeed, over the debate held in the NPG, no European high representative had questioned that "if the objective was reductions to the lowest possible level, then the ideal goal was the zero option", as affirmed by Italian Minister Lelio Lagorio.[38] This was a posture that offered the American administration the opportunity "to consider a bold plan, sweeping in nature, to capture world opinion". The foreseeable results were of the kind the government in Washington had looked for since its first days in office; in fact, Defense Secretary Caspar Weinberger noticed that, "if we adopt the 'zero option' approach and the Soviets reject

34 Note from the Arms Control and Disarmament Dept., July 21, 1981, Haig's Speech on Arms Control, TNA, FCO 46/2772.

35 Department of State Action Memorandum to the Secretary from EUR, August 8, 1981, Western Campaign – the Next Months, RRPL, Executive Secretariat, NSC Records, Agency file, box 91378; Road Map, SCG Morning Session, n.d. (though by inference, Autumn 1981), RRPL, Kraemer file, box 2, NATO – SCG.

36 Telegram from David Aaron, Reginald Bartholomew, and David E. McGiffert to the White House, October 23, 1979, JCL, digital collection, NLC 31-146-5-5-6. Thomas Risse-Kappen, *The Zero Option: INF, West Germany, and Arms Control* (Boulder, CO: Westview Press, 1988), 45-46; Lagorio, *L'ultima sfida*, 33. Risposta dell'On. Ministro alle interrogazioni ed interpellanze, Camera dei Deputati, October 31, 1979, ACS, Serie 15, NATO 5/2.

37 UK record of the 30th Ministerial Meeting of NATO's NPG held at Gleneagles on October 20 and 21, 1981, October 30, 1981, Agenda Item II: NATO's TNF posture, TNA, FCO 46/2757.

38 UK record of the 30th Ministerial Meeting.

it after we have given it a good try, this will leave the Europeans in a position where they would really have no alternative to modernization".[39]

Thus, on November 18, at the National Press Club in Washington, Reagan announced that his government was prepared to cancel the deployment of Pershing II and GLCMs if the Soviets dismantled their SS-20, SS-4, and SS-5 missiles.[40] It was, indeed, a bold proposal that was expected to reassert the American leadership and promote cohesion among Western countries. However, it was also a posture that more forcefully than ever meant that any success of the arms control track depended on the display of the Alliance's determination to proceed on schedule with the INF deployments. That was a linkage implicit in the dual-track decision which the European allies had been crucial to define and defend against any American early attempt to thwart it. However, as the negotiations on theatre nuclear systems remained bilateral, Washington ended up striving to convince its NATO partners – and especially the stationing countries – that the United States was "serious about arms control".[41]

Unfortunately for President Reagan, this turned out to be anything but an easy task to carry out. The Soviet Union, for its part, persisted in making arms control a major theme in its propaganda effort to prevent Western rearmament. By the end of October 1982, after the failure of the scheme conceived by the US negotiator, Paul Nitze, and known as the "walk in the wood" proposal,[42] a crisis of confidence between the main European capitals and Washington risked accelerating.

Among the countries committed to deploy cruise and Pershing II missiles, Italy had been the first non-nuclear weapon power to announce where the theatre forces were to be placed. The government in Rome had eventually decided for Comiso, in Sicily, where an airport had been built during World War II. [43] Certainly, the level of mobilization of Italian public opinion against the stationing of cruise missiles was not as strong as that shown by the German, British, or even Dutch, electorates. Still, Rome was the capital where Eugene Rostow, the Director of the US Arms Control and Disarmament Agency (ACDA), first mentioned the possibility of adopting a quite different American negotiating position. Talking with Corrado Taliani, the Italian Foreign Affairs Arms Control

39 National Security Council Meeting, October 13, 1981, NSC Meetings, The Reagan Files, http://www.thereaganfiles.com (a website created in 2009 by Jason Saltoun-Ebin, after he started researching Ronald Reagan in 2001, when Richard Reeves hired him as a research assistant), last accessed February 18, 2016, subject: Theater Nuclear Forces, Egypt.

40 Strobe Talbott, *Deadly Gambits: The Reagan Administration and the Stalemate in Nuclear Arms Control* (New York: Alfred A. Knopf, 1984), 38.

41 Memorandum for the President, November 14, 1981, RRPL, Executive Secretariat, NSC Records, Agency file, box 91356.

42 Talbott, *Deadly Gambits*, 117-51.

43 Lagorio, *L'ultima sfida*, 67; the day of the announcement was August 7, 1981.

Chief Minister, the American Director of the ACDA said that if it turned out that there was no future for the zero option, "we would not exclude discussion of an alternative at an appropriate time in the negotiations". He went on, then, reasoning that "for INF, an outcome providing equality at a level above zero-zero could in fact strengthen the coupling of the US and Europe in the overall nuclear context".[44]

Rostow would be dismissed by the beginning of the following year because, among other things, he had never managed to develop a close relationship with the White House.[45] However, the hypothesis he aired in Rome was to become the core of the interim solution that the Reagan administration presented to its NATO partners and to the Soviets, in the early months of 1983.[46] Indeed, an overt demonstration of flexibility by Washington was essential if the INF deployment had to preserve any good chances of proceeding according to the schedule. In other words, it was a message of cohesion and, even more, of credibility of the Alliance that all the stationing NATO countries could not fail to convey to Moscow. For those countries, and Italy among them, it was a success to hear from Vice-president George W. Bush that "the zero option was not a question of take it or leave it".[47]

The envisaging, by American negotiators, of an alternative proposal to the elimination of the TNF, however, could not avert the next failure of the Geneva diplomatic efforts. The Soviet leadership, overestimating the potential of the anti-nuclear movement in Europe, once the deployment of American missiles started, suspended bilateral talks and opted for a pressure tactic. It was a political mistake that the Politburo made out of its clear miscalculation about both the strength of the anti-missile movement and the impact the continuing deployment of the SS-20 would have on Western public opinion.[48] Without a clear understanding of how those negotiations might be resumed, the arms control talks were to wait for the advent of an unexpectedly new Soviet leader to be pursued again as a priority shared by both superpowers.

44 Telegram from AmEmbassy Rome to SecState, October 12, 1982, Rostow Consultations with Italians on Arms Control, RRPL, R. F. Lehman files, box 90710.

45 Talbott, *Deadly Gambits*, 167-69.

46 National Security Decision Directives 81-90, National Security Decision Directive 86, March 28, 1983, RRPL, National Security Decision Directives 1-250, box 1.

47 Telegram from AmEmbassy London to the White House, February 1983 and Vice President's visit: Meeting with Foreign Minister Colombo, February 7, 1983, RRPL, Executive Secretariat, NSC Records, Country files, box 21, UK.

48 Aleksandr' G. Savel'yev, and Nikolay N. Detinov, *The Big Five: Arms control Decision-Making in the Soviet Union*, trans. Dmitriy Trenin, ed. Gregory Varhall (Westport, CT: Praeger, 1995), 67-70.

Conclusion

The dual-track decision was a compromise European NATO countries had strongly pursued as their own reconceptualization of security, in which deterrence, and the relative balance of nuclear power between the two blocs, had to be combined with détente. With its adoption by the North Atlantic Council, Western Europe had succeeded in having a say about its own security and what was discussed between the two superpowers at the arms control negotiating table. In fact, in linking arms control to the modernization of the nuclear deterrent, the decision of December 1979 inevitably enhanced the role played by the United States NATO allies which acquired a bargaining power, no matter which Soviet or arms control policies the American administrations were determined to carry out.

From the archival material available, Italy appears as a participant aware of that process of enfranchisement involving West European countries, which acknowledged that they might have a security agenda distinguishable from that pursued in Washington. Indeed, it was not a matter of renouncing the defense guaranteed by the huge American arsenal. Rather, throughout the negotiations carried out between the late 1970s and the early 1980s, that implemented in Europe became a common, steady effort to develop a real cooperation with the government in Washington, whose protection and support remained essential. West Germany was the main promoter of such an effort, as no change in the balance of forces on the territory of the old continent could be discussed or conceived without the participation of Bonn. Italy, therefore, was critical for a two-fold reason. As a stationing ally, the government in Rome exerted its constant pressure on the United States in order to promote the arms control track of the 1979 NATO decision; but, as a non-nuclear weapon country, it played an even more meaningful role in taking its place beside West Germany, and in joining any discussion about the modernization and re-balancing of nuclear forces in Europe, a real perspective from which to start negotiating for their future elimination.

Part III - Public Opinion and Anti-nuclear Movements

Laura Ciglioni

Italian Mass Media and the Atom in the 1960s: The Memory of Hiroshima and Nagasaki and the Peaceful Atom (1963-1967)

The "Atomic Age"

In the early 1960s, Italians were often regarded, both by international observers, like the US Information Agency (USIA), and by Italian ones, as not very well informed about, nor much aware of, the complexities of nuclear issues and crises – especially in comparison with the peoples of other European states, in particular the West Germans, the English and the French. A 1964 USIA survey, for example, reported that, as a whole, over 70 per cent of Italians either had wrong ideas about the Partial Test Ban Treaty or ignored its existence altogether. Even the Cuban missile crisis seemed to be known only to six out of ten interviewees, while the proportion was eight out of ten in France and in the United Kingdom, and almost nine out of ten in West Germany.[1] "Atomic awareness", as well-known philosopher Norberto Bobbio later remarked, had yet to be built in Italy at the time, to the point that pondering over the "atomic condition" – as Bobbio himself claimed already in 1961 – should have been the main concern of philosophers themselves,[2] in the hope of reaching out to the men and women rightfully living submerged in the "realm" of the "everyday", suppressing the very thought of atomic death.[3]

This did not mean, however, that Italians were not afraid of the bomb – in fact, USIA surveys from the same period revealed that, on the contrary, they were particularly sensitive to the issue of nuclear weapons and favored disarmament, even general and complete, in very high numbers. Nor did it mean that nuclear energy and atomic weapons were absent from the public debate in Italy during the 1960s, in mass media too and in what could be considered the "realm of the everyday" par excellence: mass-market magazines and television. As has been noted, in fact, since the second half of

1 See Laura Ciglioni, "Italian Public Opinion in the Atomic Age: Mass-market Magazines Facing Nuclear Issues (1963-1967)", forthcoming.

2 Norberto Bobbio, *Il problema della guerra e le vie della pace* (Bologna: il Mulino, 1997), 21.

3 Bobbio, *Il problema della guerra*, 8.

the 1950s, attention and alarm for these issues had actually been growing in all sectors of Italian society, resulting in mounting anxieties, an increasing degree of mobilization, and also in a sort of "cult of the atom" taking root around its use for civilian purposes.[4] The popular press was no exception: during the 1960s, nuclear issues were a recurring object of debate, in one form or another, in the pages of illustrated magazines, and actually the possibility of the apocalypse was repeatedly presented as the current, inescapable condition for all human beings and the unavoidable starting point of any reasoning, as historian Paolo Spriano claimed from the columns of the Communist weekly *Vie Nuove*.[5] Mass-market magazines also echoed and amplified the discourse on the atom then developing in a variety of venues: the image of the ominous mushroom, multiplied on cinema screens by movies like *Fail-Safe* or *Dr. Strangelove*, was evoked in the popular press as the pictures themselves were widely discussed; the debate on nuclear weapons, sparked on the popular television program *Tribuna elettorale* during the electoral campaign of 1963, was then dissected in magazines. Likewise, the success of Virgilio Sabel's documentary *Storia della bomba atomica* (History of the Atomic Bomb, broadcast in six episodes on RAI 2 in early 1963 and watched by a high number of spectators) was both announced and reviewed for magazine readers. Mass-market weeklies gave news of the correspondence between Günther Anders and Claude Eatherly being published by Einaudi, they reviewed the theatrical play on Julius Robert Oppenheimer staged in Milan in 1964, and familiarized the readers with the idea that a poetry of the atomic age was born, heralded by Edith Sitwell, while also sculptures and operas for the atomic age were being produced thanks to artists like Agenore Fabbri and Giacomo Manzoni. Even an *Encyclopedia of the Atomic Civilization*, translated into Italian from French and distributed by the publisher Il Saggiatore, was advertised in the weekly *Epoca* through a coupon valid for buying the ten volumes.[6]

Indeed, what observers and opinion makers of all political connotations seemed to agree on was precisely the fact that humankind was then living in the "atomic age". That with the launching of the first atomic bomb on Hiroshima in 1945 a new era had dawned, and that the history of mankind had irremediably changed was something often explained not only by mass-market magazines, but remarked upon as well in tel-

4 Massimo De Giuseppe, "Gli italiani e la questione atomica negli anni cinquanta", *Ricerche di storia politica* 1 (2000): 35-44. On the early public debate, from the relative "apathy" of the mid-1940s to a wider public discussion in the late 1950s and then in the 1960s see the analysis of Matthew Evangelista, "Atomic Ambivalence: Italy's Evolving Attitude toward Nuclear Weapons", in *Italy's Foreign Policy in the Twenty-First Century: The New Assertiveness of an Aspiring Middle Power*, ed. Giampiero Giacomello and Bertjan Verbeek (Lanham: Lexington Books, 2011), 119-20. On early reactions in Italy on the issue of atomic bombs see also Luigi Cortesi, ed., *1945: Hiroshima in Italia: Testimonianze di scienziati e intellettuali* (Napoli: CUEN, 1995).

5 Paolo Spriano, "Dimensione atomica", *Vie Nuove*, March 28, 1963, 68.

6 *Epoca*, June 3, 1962.

evision programs dealing with the bomb. The program *Cronache del XX secolo: Prima di Hiroshima* (Chronicles of the Twentieth Century: Before Hiroshima), broadcast on RAI 1 at the end of July 1965, just before the twentieth anniversary of the launching of the atomic bombs on Hiroshima and Nagasaki, ended on a close-up image of the Enola Gay, flying above Japan, while the voiceover recited: "The history of before Hiroshima is by now over. … Now, as the Enola Gay approaches its target, a different history is about to begin, the history of the atomic age, with the anxieties, the fears, the anguish born on that day of August".[7]

Even more often, though, the expression "atomic age" was employed, at the time, with no need felt for further clarification or mention of the foundational event of the new era. The phrase, already in use in the Italian press in earlier years,[8] had in fact become a reference to the human condition in the postwar period as evocative and symbolic as the mushroom cloud itself was iconic. In fact, at that point, it implied a whole set of images and meanings, alluding not only to death and looming dangers, but also to modernity more in general, in both positive and negative ways. A cartoon published in *L'Europeo* in 1963 under the title "London: 'H' bomb with television camera" exemplifies these layered meanings and complex imagery related to the atomic condition. The sketch showed two men sitting in a café, one telling the other imperturbably: "They have added television to the 'H' bomb. It never rains, but it pours".[9] The atomic bomb was, after all, one of the many evils, or commodities, brought about by modernity.

Often moved by a pedagogic intent, Italian illustrated magazines felt an urge to inform the "average citizen" of "this Country of the 'miracle'" (all absorbed in his promissory notes and bills,[10] intent on dealing with the effects of the economic boom) about the atom. This over-encompassing and yet unfamiliar reality had also found its way, meanwhile, into what was then for Italians a relatively new mass media, television. This chapter investigates the representations of both fears and hopes related to the atom in the 1960s, as rendered for wide strata of Italian society by both mass-market magazines and by public television. The most culturally relevant and highly circulated illustrated magazines will be taken into consideration, as a form of journalism still extremely successful and popular at the time in Italy, which acted both as the multiplying mirror and as the molder of beliefs and sentiments widespread among public opinion. The selected magazines virtually represent the entire spectrum of Italian political cultures of the time: from the Catholic, popular weekly *Famiglia Cristiana* (the most highly-circulated with approximately 1,700,000 copies) to

7 "Prima di Hiroshima", *Cronache del XX secolo*, July 31, 1965, ed. Andrea Barbato, Teche Rai, viewed at Istituto Centrale per i Beni Sonori ed Audiovisivi, Roma, Italia (hereafter: ICBSA).

8 De Giuseppe, "Gli italiani e la questione atomica", 35n.

9 *L'Europeo*, September 22, 1963, 63.

10 Francesco Pistolese, "Carta e matita agli scienziati", *Vie Nuove*, October 31, 1963, 18.

the Communist *Vie Nuove* (the least circulated, at the time, with an average of 125,000 copies). Very popular in format and targeting a public ranging from moderate to conservative and right-wing positions were *Tempo* (dropping to 288,000) and *Oggi* (848,000), together with *Gente* (390,000) which held even more far right, anti-communist positions. *Epoca* (305,000), modeled after *Life* and *Paris Match*, had, instead, a middle-of-the-road standing combined with staunch anti-Communism. Those more cultural were *L'Europeo* (around 190,000), on moderate, lay positions, addressing an audience which stretched from the milieus close to the Social Democratic Party to the less conservative centre and to the Liberal Party, and *L'Espresso* (136,000), which gave voice to moderate leftist culture.[11] In addition, will be taken into consideration television programs broadcast by the two public networks existing at the time in Italy, RAI 1 and RAI 2, dealing with nuclear issues and particularly successful with the audience or significant for the broader public debate.

The analysis focuses on the period from the aftermath of the Cuban missile crisis and the signing of the 1963 Partial Test Ban Treaty up to the beginning of the debate on the Non-Proliferation Treaty (NPT) in 1967. The period taken in consideration was, on the domestic front, also a time of deep transformation in Italy, both in terms of political developments (with the long-prepared inclusion of the Socialist Party into government taking place) and of relevant social and cultural changes. The fears of the atomic age are analyzed through the memory of Hiroshima and Nagasaki, chosen as a litmus test in as much as it represents one of the privileged venues for both molding representations of the atomic bomb and negotiating fears. "Atomic hopes" are investigated, instead, by examining the emergent fascination for the peaceful uses of atomic energy then spreading, analyzed here as the catalyst for a positive perception of the atom at a time when national energy policies were experiencing a crucial turning point.

The Memory of Hiroshima and Nagasaki in Italy Twenty Years Later

In 1967, a two-page spread with an advertisement featuring a huge mushroom cloud, full-page size, appeared in mass-market magazines to promote an encyclopedia of

11 On periodicals and their circulation, reported here as it was in the late 1960s, see Nello Ajello, "Il settimanale di attualità" and Laura Lilli, "La stampa femminile", in *La stampa italiana del neocapitalismo*, ed. Valerio Castronovo and Nicola Tranfaglia (Roma-Bari: Laterza, 1976), 173-311; Mario Marazziti, "Cultura di massa e valori cattolici: il modello di 'Famiglia Cristiana'", in *Pio XII*, ed. Andrea Riccardi (Roma-Bari: Laterza, 1984), 307-33; *La bella addormentata: Morfologia e struttura del settimanale italiano*, intr. Arturo Quintavalle (Parma: Istituto di Storia dell'arte, 1972). For *Vie Nuove* see *Conferenza nazionale della stampa comunista. Rapporto di Emanuele Macaluso. Intervento di Luigi Longo. Risoluzione. Roma, 16-17 dicembre 1966*, Archivio Partito Comunista, Sezione stampa e propaganda, mf 0530, p. 2436, Istituto Gramsci, Roma.

World War II sold in weekly installments.[12] The slogan, written over the atomic mushroom itself, and continuing across the opposite page, read: "This is how it ended. But how did it start?". The image of the atomic explosions over Hiroshima and Nagasaki and the memory of the event that had marked the end of the recent war were, in fact, all but erased in Italian mass media. If the anniversary of 1965, in particular, provided an occasion for extensive commemorations and reports – also on television, as seen above –, dossiers promising to finally uncover the "secrets of the bomb on Hiroshima",[13] detailed articles, and white papers recurred over the years in the pages of mass-market magazines, not necessarily marking symbolic dates or events, like the 1964 Tokyo Olympics. Likewise, the story of how scientists, revered priests of the "atomic age", had created the bomb, the history of the Alamogordo test, interviews with nuclear physicists or with their families kept being published in the popular press and aired on television during the decade, and actually constituted in illustrated magazines a minor genre within the broader, well present memory of World War II.

The persistence of the memory of Hiroshima, and of all the men and facts related to it – which, somehow, seemed to eclipse the memory of Nagasaki, usually mentioned but seldom at the centre of the narrative – may lie in the fact that it provided a partial possibility to give more precise outlines to a post-atomic scenario. While all sorts of nuclear fears clouded the minds of Italians and were then evoked in the public debate, they were always revolving around the unknown and the invisible – proliferation, the Chinese and French atomic bombs, Germany trying to "get a finger" on the nuclear trigger, the Vietnam War and the risk of escalation toward a nuclear World War III, contamination and pollution by nuclear waste.[14] Hiroshima and Nagasaki, instead, allowed men and women of the atomic age "to look under the mushroom cloud", at the consequences of the dreaded explosion.

American historian John W. Dower noted that directing the gaze under the atomic mushroom has often been unbearable for Americans and American culture.[15] In the case of a country that, like Italy, not only had not launched the bomb, but did not even have an atomic arsenal, looking at Hiroshima and Nagasaki was probably partially easier, though not necessarily unproblematic. In the popular press, for example, while the textual descriptions of the explosions and of the consequences of the atomic bombs offered

12 See for example *L'Europeo*, October 19, 1967, 98-99; *Oggi*, October 5, 1967, 114-15.

13 Advertisement of a reportage featured in the September issue of the monthly periodical *Successo*, published in *Tempo*, September 7, 1963, 19.

14 See Ciglioni, "Italian Public Opinion in the Atomic Age".

15 John D. Dower, "Three Narratives of our Humanity", in *History Wars: The Enola Gay and Other Battles for the American Past*, ed. Edward T. Linenthal and Tom Engelhardt (New York: Metropolitan Books, Henry Holt and Company, 1995), 87.

to the Italian readers were vivid, horrific, and detailed, the visual representation of the atomic catastrophe was definitely more restrained. With the exception obviously of *Vie Nuove*,[16] and especially of *Epoca* (the magazine, infact in 1965 gave ample space to the photos of a wounded child amid ruins and of other injured, dying victims, some already published in *Life* in 1952),[17] photographs available in illustrated weeklies concentrated more often on symbolic buildings and objects, like the well-known dome of Hiroshima, rather than on human victims or images of devastation. The published pictures of the *hibakusha*, for example, were usually small or not very explicit, with mutilations and scars or swollen limbs barely visible. Television programs were even less explicit and tended to focus on the moments preceding the explosion. The broadcast dedicated to the commemoration of Hiroshima in the summer of 1965, for instance, as mentioned above, ended with the Enola Gay flying over the city, just before the actual launch of the bomb took place. The program lengthily focused on the three months of war before the launch and on the decision-making process leading to it. In very much the same way, the long documentary *Storia della bomba atomica*, aired between February and March 1963 – a severe denunciation of the evils of nuclear weapons –, virtually ended its extensive narration of the history of the bomb focusing on the dramatic moments before the launch over Hiroshima, followed by images of atomic blasts and of mushroom clouds monstrously expanding in the sky. The story then swiftly moved on to interviewing the protagonists of the event about their responsibilities and eventual feelings of repentance – the scientists and General Leslie Richard Groves –, and closed with an open-ended, mildly optimistic conclusion about the disarmament talks in Geneva.[18]

In almost all the weeklies, moreover, the descriptions of the enduring and unspeakable sufferings not shown, but clearly described in the journalistic texts, were compensated by photos of a rebuilt, modern Hiroshima. In 1965, *Oggi* even titled one article "Hiroshima: metropolis of tourism":[19] color and black and white images of a lively and bustling city contributed to relegate the atomic bomb in the past as a very dramatic episode, but an episode after all. Quite significantly, opinion makers of all political connotations seemed compelled to end their articles on the same consoling note: the

16 See for example Enrico Bordini, "Quel giorno a Hiroshima", *Vie Nuove*, July 22, 1965, 47.

17 See "Ricordiamo Hiroshima", *Epoca*, August, 1, 1965, 18-25. On the photos of Hiroshima and Nagasaki after the atomic bombing see Dick van Lente, ed., *The Nuclear Age in Popular Media: A Transnational History, 1945-1965* (New York: Palgrave Macmillan, 2012). For *Life* issue of September 29, 1952 see Peter Bacon Hales, "Imagining the Atomic Age: Life and the Atom", in *Looking at Life Magazine*, ed. Erika Doss (Washington and London: Smithsonian Institution Press, 2001), 103-19, esp. 112-15.

18 *Storia della bomba atomica*, episode 6, March 22, 1963, program by Virgilio Sabel, Teche Rai, ICBSA. Giuseppe Berto and Ginestra Amaldi collaborated with the program.

19 Silvio Bertoldi, "Hiroshima: metropoli del turismo", *Oggi*, August 12, 1965, 46-52.

reassurance that the people of Hiroshima felt no hate, that they had forgiven and simply wanted their terrible experience to be a warning for the future.[20]

This representation of Hiroshima twenty years after was accompanied in mass-market magazines by a discussion of the attitude of the younger generations of Japanese living in the city, americanized in their taste and dreams, and particularly willing to forget the painful past and move on. Such a representation mirrored, in the first place, the analogous divide perceived as increasingly wide and harsh in Italy between the generation who had lived through World War II and the children of the postwar years and of the economic boom. This was also a confrontation between the generation that had built the bomb and the one that may have to suffer from it, as very well exemplified by a 1964 interview by *Europeo*'s young journalist Oriana Fallaci with Laura Fermi, wife of the Italian physicist Enrico Fermi.[21]

In the Italian public debate Hiroshima represented, first and foremost, the occasion for a straightforward condemnation of the use of the atomic bomb: it epitomized the taboo against the *use* of this weapon, for all political cultures, no space for hair-splitting distinctions or strategic considerations allowed – even if this did not necessarily imply, of course, a similar attitude toward nuclear arsenals and policies more in general. Survivors were the protagonists of this narrative in illustrated magazines: they were interviewed, photographed, and became mediators between two different eras. Paul Boyer argues that in the United States "the degree of attention accorded to Hiroshima and Nagasaki as symbols of a future to be avoided can be correlated closely over time" with the waves of increased anxiety for atomic weapons and anti-nuclear activism developing in America – from John Hersey's *Hiroshima* written in 1946, to the activism and fears of the mid-1950s-early 1960s, up to the Reagan years in the 1980s.[22] With regard to the American magazine *Life*, in particular, scholars have made the point that pictures of Hiroshima victims and a darker narrative of the bomb started to be published not only when it became technically possible, that is when "the AEC loosened its hold", but also when the arms race and several disturbing accidents, occurred during the late 1940s-mid 1950s, made the menace the bomb posed *for Americans* impossible to ignore or silence. It thus became preferable to frame the atomic bomb in a complex narrative exploiting peo-

20 See Gabriella D'Angeli, "La visione dell'inferno le indicò la via del cielo", *Famiglia Cristiana*, September 12, 1965, 14-17; "Le ragazze senza chimono", *Vie Nuove*, August 27, 1964, 10-15; Ricciotti Lazzero, "Ascoltate il cuore di Hiroshima", *Epoca*, October 18, 1964, 124-29; for a partially different view on the theme of Japanese memory of the bomb, see Rafael Steinberg, "I figli del 6 agosto", *L'Europeo*, August 15, 1965, 42-49.

21 Oriana Fallaci, "Atomi amari", *L'Europeo*, May 10, 1964, 42-49.

22 Paul Boyer, "Whose History is This Anyway? Memory, Politics, and Historical Scholarship", *History Wars*, ed. Linenthal and Engelhardt, 115-39, qt. 124.

ple's fears and reasserting the "atomic sublime" at the same time.[23] Instead, for a country that, like Italy, did not have the bomb, and could therefore only eventually be a victim of it, this perspective focusing on victims and the appalling consequences of atomic explosions was probably particularly significant. Treatment of this issue was not taken as far as to shock readers, but rather aimed at reassuring while satisfying a widespread thirst for knowledge and at the same time reasserting the condemnation of the bomb.

The commemoration of Hiroshima also provided, however, the occasion for weighing responsibilities. The long chain of events and decisions leading to the flight of the Enola Gay, the almost random final verdict determining the targeted cities, based on meteorological considerations, were sources of uneasy questions and speculations both in the popular press and on television, and definitely constituted the other pole around which the memory of these events revolved. The main issues were the same already raised by the Franck report in 1945: the choice of bombing civilian targets and the refusal to warn the enemy with a demonstrative launch. The Franck report itself posed a problem: how much had it circulated? Had it been known at the top levels? Finally, the very necessity to drop the bomb to end the war was questioned, and, in some cases, also the tensions emerging at Potsdam were hinted at. Detailed accounts of the decision-making process were therefore at the centre of the public debate, in an attempt to determine the respective responsibilities of the military, the scientists, and politicians, especially Harry Truman. Photos and biographies of the protagonists, from the crew of the Enola Gay to the men of Los Alamos, peopled the pages of illustrated magazines and were replicated on television screens. The documentary *Storia della bomba atomica* put, essentially, physicists on trial – from Marie and Pierre Curie to the school of Göttingen, down to Fermi –, with Oppenheimer, whose tormented figure well epitomized collective feelings of guilt and all the contradictions of twentieth-century science, as the main accused.

The fractures of the Cold War obviously played a crucial role in determining views and attitudes toward the dropping of the atomic bombs on Japan, separating the violent accusations of the Communist weekly *Vie Nuove* against the United States from other, more nuanced positions. In *Vie Nuove*, the creation of the bomb was presented, in fact, as an operation marked from the beginning by subterfuges and blatant lies, painful deaths, and immoderate personal ambition. Oppenheimer was, in this case, the embodiment of a completely negative myth: he was responsible for being exclusively allured by the "technically sweet", and represented the mistakes and cynicism of the United States in building the atomic bomb first, and then in using it on Hiroshima and Nagasaki as a form of blackmail actually aimed at the Soviet Union. In short, all the doubts and questions suggested in other narratives found in this magazine clear answers and a

23 Hales, *Imagining the Atomic Age*, 112-18.

well-identified culprit: the United States, guilty of an awful crime perpetuated solely in the pursuit of power politics. These ideas were expressed in the Communist magazine together with the reassurance that the Soviet Union – which, "luckily for her"[24] and for world peace, had been able to catch up and close the technological gap –, would never be the first to use nuclear weapons and actually desired a "global and simultaneous" disarmament.[25] Articles presented also information and photos of the anti-nuclear movement around the world, Hiroshima included.[26]

In right-wing and moderate magazines, as well as in what may be identified as mainstream narratives, a clear hierarchy of responsibilities, instead, was not always identified: the haunting questions were just posed for readers and spectators, adding, after all, to the interest of these journalistic reconstructions, and nourishing the public's curiosity, doubts, and probably fears. One solution proposed in this kind of narratives was to focus on the mourning for the victims, avoiding delving "into polemics" which – as *Oggi* wrote – would obscure "reality", a reality that simply had the face of a city called Hiroshima.[27] This was especially the case of moderate and conservative popular magazines, in which a "neutral" memory of Hiroshima and Nagasaki was also framed within a broader reassuring and elegiac memory of World War II, focused on sufferings and rather oblivious to other kinds of more political considerations.[28] In other cases, like in *Epoca* or on television,[29] the public was also reminded of some of the elements of what has been defined by scholars the American "heroic narrative":[30] that the bombs had probably saved thousands of lives, both American and Japanese, and ended the war. In most of these popular narratives, scientists were, in the end, presented as maybe reckless or blind to the consequences of their actions but not without scruples, the vessels of a knowledge and progress that could have hardly been stopped. The turning point was often identified, actually, in the intervention of politicians and, even more, of the military, which marked the moment in which – like Sabel's documentary explained – "the atomic bomb [had] entered for good into the history of humankind" and physicists had left the scene.[31] If a more unambiguous culprit was to be found in these reconstructions, it was definitely General Groves, who embodied bureaucratic militarism, the logics of war itself, and aptly personified all the most disquieting aspects of the event in what remained, after all, a relatively minor char-

24 Enrico Bordini, "Gli anni del terrore", *Vie Nuove*, July 29, 1965, 45.
25 Enrico Bordini, "Vivere con la bomba", *Vie Nuove*, August 5, 1965, 32-44.
26 See Bordini, "Quel giorno a Hiroshima", 48.
27 Bertoldi, "Hiroshima", 52.
28 See Laura Ciglioni, "Le guerre italiane nei rotocalchi degli anni Sessanta", *Mondo Contemporaneo* 1 (2010): 141-51.
29 *Prima di Hiroshima,* ed. Barbato.
30 Dower, "Three Narratives", 71-73.
31 *Storia della bomba atomica*, episode 6.

acter. In a few cases, such as in *Famiglia Cristiana*, the account of the frantic unrolling of events, started by modern science and accelerated toward tragedy by the intervention of the military, was combined with a clear advocacy of disarmament, viewed as the only possible path to "safety" in the face of the "apocalypse created by men".[32]

With all these attempts at rationalization and comprehension, the first bomb also remained in mass-market magazines and in television programs a source of dramatization and of very powerful narrations, which employed a series of rhetorical devices based on, and contributing to, the "atomic sublime": the mushroom cloud was reproduced over and over in all its stunning monstrosity for a passive, awestruck audience. It was presented as both a fantastic spectacle, comparable to an incontrollable force of nature, and one of the wonders of the modern world created by men[33] – one of the many that peopled mass-market magazines and television screens in a decade of growing consumerism and fast modernization. The fantastic, the divine, or magic are themes often associated with the atomic bomb in popular cultures, both in utopian and dystopian ways. Spencer R. Weart, in his *Nuclear Fears*, indicates *transmutation*, a concept linked to alchemy, as the main recurring narrative on the atom.[34] Italian mass culture was no exception, and in the narratives on the Alamogordo test and on the first bomb, references to Armageddon, to the "lapse into sin" of human beings, to the unleashing of a divine kind of force were recurrent in illustrated magazines, especially in those targeting a more popular audience. They were evoked just as much on television, where to the strength of the words of mesmerized witnesses of the event, horrified or rapt, repeated by voiceovers, the dramatic force of climaxing music and of ominous images of fires, fierce winds, boiling liquids, and clouded skies were added, to captivate the attention of the public.

The Cult of the Atom: Civilian Uses of the Atomic Energy

The atom was, indeed, also a source of deep fascination. Very often this enthrallment was tinged with rather sinister undertones, as seen above: extreme risk, power and control over nature, genius, secrecy, mystery, and a sort of arcane, rapt fear were all underlying factors contributing to this kind of interest. They were all nourished by a degree of concealment intrinsic to atomic issues, both due to military concerns and to the tremendous complexity of the subject itself.

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32 See for example M. G. Bevilacqua, "Vent'anni fa scoppiava l'atomica", *Famiglia Cristiana*, August 8, 1965, 35-41.

33 On the atomic sublime, particularly in *Life* and in American culture, see Hales, "Imagining the Atomic Age", 114, 118-19n.

34 Spencer R. Weart, *Nuclear Fears: A History of Images* (Cambridge: Harvard University Press, 1988).

However, a less dark and more optimistic form of fascination for the atom was becoming increasingly present in the Italian public discourse on atomic issues during the 1960s: its catalyst was the "peaceful" atom, and it developed around the civilian uses of nuclear energy. If an initial "cult of the atom", as seen above, had been developing in Italy in the second half of the 1950s, especially in the aftermath of the 1955 International Conference on the Peaceful Uses of Atomic Energy of Geneva,[35] a decade later these sentiments seemed to have spread in most political cultures. The appeal of the atom relied, in this case, on a vision of endless possibilities and progress, based on a reputedly infinite energy source: "our dreams won't have limits", announced *Epoca* in presenting a 1966 report on "The prodigious power of the atom".[36] From curing illnesses to exploring the depths of the sea, to the prospect of modifying plants and animals, and even climate, mass-market magazines dreamt of a world where, by the year 2000, oil and indeed any other form of energy would be replaced by nuclear power.[37] The peaceful atom was widely regarded as the future of civilization; it was, again, a promise of transformation and fantastic transmutation. Also *Vie Nuove* built its own powerful narrative related to the peaceful uses of the atom: on the one hand, it was centered on its open, consistent support for a public, generously financed nuclear scientific research in Italy; on the other, it focused on the initiatives and progresses of the Soviet Union. According to the communist magazine, in fact, in the Soviet Union the most advanced research was conducted and the safest techniques implemented in the best interest of the people, without the tyranny of the market-economy and the interests of big industries to hinder or thwart progress.[38]

In other countries a "cult of the atom" had developed also around the celebration of, and the fascination for national nuclear arsenals, usually in defensive terms, often as part of national nuclear programs more generally. In an extremely popular magazine like the American *Life*, for example, in the early 1960s atomic submarines, defense systems, and even Minuteman silos were presented as objects of beauty, technologically superb weapons and at the same time as providing a healthy and safe, challenging environment or occupation for young, brave men.[39] In the pages of the French *Paris Match*, the visits of

35 De Giuseppe, "Gli italiani e la questione atomica", 43-44.

36 Franco Bertarelli, "La Prodigiosa forza dell'atomo", *Epoca*, December 25, 1966, 43-58.

37 Portolano, "La silicosi del 2000", *Vie Nuove*, November 21, 1963, 40. See also Mauro Calamandrei, "Ho visto nascere il mondo del futuro", *L'Espresso*, November 6, 1966, 16-19; Calamandrei, "Le mani sull'universo", *L'Espresso*, November 13, 1966, 16-21.

38 See for example Portolano, "Delusione atomica", *Vie Nuove*, May 9, 1963, 44; Portolano, "L'atomo per la pace", *Vie Nuove*, February 28, 1963, 82.

39 See *Life*: Robert Brigham, "Polaris Sub Prowls the Sea", *Life*, March 22, 1963, 22-31; Carl Mydens, "Here the U.S. Fights the Coldest War", *Life*, March 1, 1963, 18-29; Bill Ray and Richard B. Stolley, "How it Feels to Hold the Nuclear Trigger", *Life*, November 6, 1964, 34-41.

de Gaulle to Pierrelatte, the "*fantassins de l'apocalipse*" (foot soldiers equipped for atomic war), the "*antiatomique*" flagship Jeanne d'Arc, the space program and its possible eventual developments were all enthusiastically presented to readers in a narrative that put the atom and atomic defense at the centre of the vision of a young, proud nation.[40] More generally, in France, as Gabrielle Hecht has brilliantly argued, a narrative presenting the atom as a way to national redemption and salvation – the "radiance of France" –, had been crafted by politicians, technologists, and journalists since the postwar years.[41] In a country that, like Italy, did not have its own nuclear weapons, and would relatively soon give up building them altogether, obviously very few weeklies tried to give life to a narrative centered on nuclear weapons and the nation's military power or pride. Attempts at it were limited to the moderate and right-oriented magazines like *Epoca*, *Tempo* or *Oggi*. The main themes of this narrative were essentially two: the first was centered on Italy being as up-to-date in technology as any other country (as shown by military anti-nuclear exercises in the North of the peninsula),[42] and basically able to build its own atomic bombs, but too civilized to do so. The second was focused, instead, on the celebration of the Italian genius, seen at work in this field as in all others: a view well exemplified by the presentation of the cruiser Garibaldi, just equipped to launch Polaris – whose firepower was described as "four times bigger than all the bombs launched during World War II, including Hiroshima and Nagasaki" –, as a completely "Italian" effort.[43]

As this narrative remained isolated and barely sketched, the civilian atom acted instead as catalyst for a positive perception of nuclear energy, not tinged with uneasiness, and for a modern "cult" of progress and, to a certain extent, national advancement. Research on nuclear energy was not usually portrayed as a national endeavor, not in the way it was in France,[44] and in some cases, notably in *L'Espresso*, it was actually pictured

40 See *Paris Match*: "Ce que va a être la France atomique et spatiale", *Paris Match*, January 26, 1963, 18-21; "Il command un sous-marine atomique", *Paris Match*, April 20, 1963, n.p.; "La Jeune Armée Française", *Paris Match*, August 3, 1963, n.p.; Jean Durieux, Charles Courriere, and Georges Menager, "Prêt a affronter sa force de frappe", *Paris Match*, October 5, 1963, 54-57; "C'est la Jeanne D'Arc Anti Atomique", *Paris Match*, March 28, 1964, n.p.

41 On the promoters and opponents of this narrative, and on its diffusion over time, at the national and regional levels, see Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge: MIT Press, 1998). On atomic culture in France see also Beatrice Heuser, *Nuclear Mentalities? Strategies and Beliefs in Britain, France and the FRG* (Basingstoke: Macmillan, 1998).

42 "Un'atomica è caduta a Pordenone", *Epoca*, August 9, 1964, 70-73.

43 Luigi Romersa, "La fortezza galleggiante dell'Italia", *Tempo*, February 16, 1963, 11. See also Livio Pesce, "Andreotti: ora con i 'Polaris' non siamo neppure in serie B", *Epoca*, February 24, 1963, 26-27. On the role of the *Garibaldi* in the debate on nuclear sharing within the NATO since the half of 1962 see Leopoldo Nuti, *La sfida nucleare: La politica estera italiana e le armi atomiche 1945-1991* (Bologna: il Mulino, 2007), 241-62.

44 See Hecht, *The Radiance of France*.

more as a European effort and, more generally, as an aspect of the tremendous progress then unrolling before all humankind. Nonetheless, scientific research on the civilian uses of atomic energy was at that point considered irremissible in very different milieus, and widely regarded as vital – as even a periodical like *Famiglia Cristiana* acknowledged in some measure[45] – to keep Italy on a par with other industrialized countries, or at least not lagging behind.[46] In fact, the appeal of the civilian uses of nuclear energy was so general and enthusiastic that it was also used, on the occasion of the debates on the Multi Lateral Force and, later, on the NPT, as a sort of "passkey" argument, mentioned (more or less in earnest) by all the voices stressing the possibilities and advantages that Italy may have, in the first case, gained, and in the second case, lost. Besides, the development of a nuclear energy policy was not perceived as fundamentally at odds with the artistic and historical attractions of the country: rather, the futuristic domes and the chimneys of the first nuclear plants built in the peninsula were heralded as a new "architecture of the atom", stunning in its cold modernity.[47] Even a region "of past glories" like Salento, in Apulia, with its beautiful Baroque, was considered, in a very conservative weekly like *Gente*, not endangered by the Centre Européen pour la Recherche Nucléaire synchrotron planned in the small city of Nardò, but projected instead toward a "science-fiction future" of economic recovery, flourishing agriculture, and also tourism arising from it.[48]

Also on television, the peaceful atom was a multifaceted protagonist. Programs dealing with atomic energy and the atom ranged from educational broadcasts intended for students[49] to science and cultural programs offering in-depth analyses of a wide range of issues: from the principles of atomic fission and atomic fusion[50] to the wonders of space programs,[51] from the problems posed by underdeveloped nations relying on nuclear energy[52] to the growth of futuristic "atomic towns".[53] The atom on television seemed to have mainly the purpose of educating and, at the same time, reassuring viewers of the safety of the modern technologies implemented in nuclear power plants and for other pacific uses. As the program *Storia dell'energia* explained to the audience of RAI 1 with the aid of graphics and models, energetic possibilities had enormously swelled

45 See for example "Grave crisi all'Euratom", *Famiglia Cristiana*, January 17, 1965, 32.

46 See for example Adriano Buzzati-Traverso, "Lo scienziato a mezzo servizio", *L'Espresso*, November 14, 1965, 14; Antonio Gambino, "L'Europa in bicicletta", *L'Espresso*, December 25, 1966, 9.

47 Bertarelli, "La Prodigiosa forza dell'atomo".

48 Mario, Gismondi, "La patria del Barocco punta sull'atomo", *Gente*, November 15, 1967, 64-67.

49 *L'avanzamento della scienza*, May 23, 1967, Teche Rai, ICBSA.

50 "Energia nucleare", episode 10, and "Il futuro", episode 11, *Storia dell'energia*, July 11 and 18, 1967, ed. G. B. Zorzoli, Teche Rai, ICBSA.

51 *Finestra sull'universo*, episode 16, February 22, 1964, Teche Rai, ICBSA.

52 *La fame e la bomba*, November 30, 1964, Teche Rai, ICBSA.

53 *Il Giornale d'Europa*, episode 12, May 20, 1967, Teche Rai, ICBSA.

for humankind and there was much more than explosions and bombs to develop from the atom, including electric energy at competitive prices.[54] If mushroom clouds and references to Hiroshima often interspersed these programs, as well as concerns about proliferation and civilian nuclear programs serving as launching pads for military purposes, visions of a radiant future took shape on domestic television screens: visions of space explorations and moon-landings, of more and more satellites circling the earth, and live, simultaneous broadcasts of entertainment programs in multiple countries, all relying on nuclear energy. These programs, through relying on spectacular stock images and graphic animations, substantiated the allegedly "widely shared belief" that "human progress [would] increase along with the development of atomic energy", as a 1964 program on Systems for Nuclear Auxiliary Power (SNAPS) stated.[55] Technicians in white coats opened the doors, for Italian television spectators, to ultra-modern plants and reactors, with their metallic stairs and control panels, and their secret, concealed core of atomic power throbbing "like an octopus" in its "metaphysic pool". The show of "Man in control of the Atom" was on display: in the world of automation and of machines, if "men seemed weakened by the awareness of their limits and their vulnerability", they were also "sustained by their hopes and their pride", their eyes and their hands "attentive but not afraid".[56]

In this atmosphere of growing excitement for the peaceful uses of the atom, the "Ippolito scandal", that concerned the management of the institute in charge of nuclear research in Italy, the Comitato Nazionale per l'Energia Nucleare (CNEN), raged on the pages of the popular press for several months, especially between 1963 and 1964. Besides being viewed simply as a case of mismanagement and corruption in a country that had become too rich too quickly, the case definitely embodied for certain circles the evils of state intervention in energy policies, and more specifically the dangers intrinsic in the political culture of the centre-left governments.[57]

54 "Energia nucleare", episode 10, *Storia dell'energia*.

55 *Finestra sull'universo*, episode 16.

56 *Il Giornale d'Europa*, episode 12.

57 See for example Giorgio Pecorini, "Le sorprese dell'atomo", *L'Europeo*, September 8, 1963, 36-39; Ettore Della Giovanna, "Quando lo stato diventa imprenditore", *Oggi*, September 12, 1963, 12-15. Analyzing the broader political implications of the scandal and the public debate raging over it, *L'Espresso* remarked – all considerations on Ippolito's responsibilities aside – how a large part of the press campaign against him seemed to have been aimed above all at persuading Italians that state intervention was dangerous, that "all things touched by the State result[ed] contaminated and that, therefore, there [was] no other option but [to implement] a daring program of privatization" (*L'Espresso*, September 15, 1963, 1); in short, the goal seemed to have been discrediting both CNEN and Ente Nazionale per l'Energia Elettrica (ENEL).

Conclusion

On the eve of the 1963 political elections, the secretary of the Partito Comunista Italiano (PCI) Palmiro Togliatti devoted to the atomic threat a large portion of his final address to voters during the television program *Tribuna elettorale*. In urging Italians to reject the equilibrium of terror and the Atlantic loyalty which, through the proposed Multilateral Force, burdened Italy with the menace of the bomb, he vibrantly asked: "Why should this homeland of ours", where "so many treasures of a great civilization are gathered, be exposed today to the risk of total destruction in the apocalyptic catastrophe of a nuclear war? [...] Our whole civilization [is] pushed to the verge of an abyss, at whose bottom total destruction may lay".[58] If Togliatti was perhaps confident to evoke deep-seated fears, equally resonating with the audience was probably the program that, less than a year later, depicted the wonders of the peaceful atom, described as crossing the boundaries of the Earth, at that very moment, to reach for space and add "a new friend" to the stars, in order to guide human beings through seas, lands and skies.[59]

Thus, "atomic fear" and "atomic hope", in the words of *Vie Nuove*, dominated the decade,[60] and were actually perceived as two possible outcomes for human civilization. Atomic energy seemed to embody both a negative notion of modernity – an impersonal civilization of machines crushing men – and a positive one, probably rooted in the optimism of the economic boom years: the vision of a hyper-modern, technological Italy, on a par with other nations. It is to be noted, however, that fear was maybe prevailing over hope or faith in futuristic scenarios, for the moment. While anxieties were well-rooted and rather ubiquitous, the hope for the civilian atom was still blossoming at the time. It remains to be seen whether it had space to continue to grow after the end of the 1960s, in consideration of both the future developments of nuclear scientific research and energy policies in Italy, and of the new international scenario opened by the signing of the NPT.

58 *Tribuna elettorale*, April 25, 1963, Teche Rai, ICBSA; see also *L'Unità*, April 26, 1963, 1, 12.

59 *Finestra sull'universo*, episode 16.

60 Portolano, "Delusione atomica".

Giulia Iannuzzi

Italian Science Fiction, Nuclear Technologies: Narrative Strategies between the "Two Cultures" (1950s-1970s)*

In 1953, the refined poet and critic Sergio Solmi wrote that science fiction could be read as the mythology of the atomic era.[1] While Solmi's words were not intended to axiologically judge the value of science fiction as a genre, or that of nuclear technology *per se*, often, over the following years, the term "nuclear age" when used by Italian writers really meant "the age of the nuclear threat", and "science fiction" the literature of this new, blighted world.

This chapter aims to portray and critically investigate how science fiction interacted with and contributed to the development of a collective imagery related to nuclear energy in Italy, within the context of a culture characterized, during the twentieth century, by a difficult relationship between the "two cultures".[2] To do this, I shall be looking at how the theme of nuclear technologies was dealt with in two different discursive practices: on the one hand, its treatment within science fiction genre narratives written by Italian authors; on the other hand the treatment of science fiction and the nuclear theme on the part of Italian (non-genre) writers. Both will be illustrated through a selection of cases, and the association between science fiction and nuclear technologies will show that the initial enthusiasm for the new technology was part of new hopes connected to an unprecedented modernization of Italy and a new centrality of techno-science, while

* I would like to thank all the attendees of the *Nuclear Italy* conference (Trieste, 2014) who with their questions and observations helped me improve the original draft of this paper: Matthew Evangelista, Cinzia Ferrini, Gianrossano Giannini, Igor Londero, Gianni Paoloni, Carlo Rizzuto, Elisabetta Vezzosi. This work also draws on conversations and exchanges of ideas for which I am in debt to Elisabetta Bini and Barbara Curli. For the revision of the English I would like to address my heartfelt thanks to Judith Moss. Last, but not least, I wish to express my deepest gratitude to Fabiano Stefanini, whose friendship and support have been an invaluable help in conducting this research.

1 Sergio Solmi, "Divagazioni sulla *science-fiction*, l'utopia e il tempo" (1953), in Solmi, *Della favola, del viaggio e di altre cose. Saggio sul fantastico* (Napoli: Ricciardi, 1971), 61-110.

2 Pierpaolo Antonello, *Contro il materialismo. Le «due culture» in Italia: bilancio di un secolo* (Torino: Aragno, 2012).

the hostility toward both of them on the part of the Italian cultural elite, especially during the decades 1960s-1970s, can be interpreted as two different sides of what we may call the same "malaise of modernity".

To introduce the topic, I will explain why I think these literary expressions are of interest in a collective research work such as the present volume, designed to explore the international history of the Italian nuclear experience.

Introductory Remarks: Science and Fiction, History, Imagery

As science fiction is a field of literary production characterized by a vast range of possible connections with the sciences, it is an ideal standpoint from which to scrutinize the interactions between literary culture and the hard sciences in a given cultural context.

While this might sound obvious, science fiction is usually ignored in scholarly works on science and literature,[3] just as it is still marginalized by many scholarly traditions of literary studies, such as Italian studies in Italy. We could go as far as to say that, even today, science fiction still arouses (together with techno-science, and nuclear technologies) the same feelings of mistrust it aroused among Italian cultural elites during the economic boom. In fact, an interesting parallel could be drawn between science fiction as a recognizable literary genre and nuclear technologies as represented during the 1960s and 1970s: two expressions of the same process of modernization, at different levels – of literary and cultural industry the first, of research, development and industry the second. Science fiction was a genre especially concerned with techno-science, featuring in popular publications, sold at news-stands for a new mass public appearing for the first time (in Italy) in the years of the "economic miracle", looked upon with suspicion by an Italian cultural elite which was nominally much more democratic with regard to politics than cultural practices.[4] The fact that during the 1950s, science fiction started being identified with translations of Anglo-American and especially American authors[5] was another reason for Italian intellectuals to distrust a genre perceived as a product of American cultural colonization, as a "popular" form of literature, but with

3 Gary Westfahl and George Edgar Slusser, eds., *Science Fiction and the Two Cultures: Essays on Bridging the Gap Between the Sciences and the Humanities* (Jefferson: McFarland, 2009).

4 David Forgacs, *Italian Culture in the Industrial Era, 1880-1980: Cultural Industries, Politics and the Public* (Manchester: Manchester University Press, 1990); David Forgacs and Stephen Gundle, *Mass Culture and Italian Society from Fascism to the Cold War* (Bloomington: Indiana University Press, 2007).

5 Pierpaolo Antonello, "La nascita della fantascienza in Italia: il caso 'Urania'", in *Italiamerica. L'editoria*, ed. Emanuela Scarpellini and Jeffrey T. Schnapp (Milano: Il Saggiatore, 2008), 99-123; Giulia Iannuzzi, *Fantascienza italiana. Riviste, autori, dibattiti dagli anni Cinquanta agli anni Settanta* (Milano: Mimesis, 2014); Iannuzzi, *Distopie, viaggi spaziali, allucinazioni. Fantascienza italiana contemporanea*

"popular" used pejoratively – produced in a top-down direction to entertain and distract the masses. At the same time, the dominant school in Italian literary criticism during the first half of the twentieth century, the "*idealismo*" established by Benedetto Croce, espoused an exalted idea of poetry while tending to penalize narrative in general, saw popular narrative genres as inferior literary forms, and looked down on the hard sciences and technology as subsidiary forms of knowledge.[6]

In this chapter I hope to contribute to draw the broader picture of the atom and public opinion in Italy.[7] In the following pages, I will also present another side of the story: it should not be forgotten that in the course of the twentieth century, science fiction had a role in building many of the rhetorical *topoi* and themes used to discuss scientific issues. Numerous authors have played their part in developing our linguistic and imaginary repertoire as regards nuclear energy and weapons, sometimes anticipating the success of works of scientific popularization. Patrick Parrinder, for example, has underlined the importance of science fiction techniques in the field of so-called "futurology" or "future studies".[8]

These are some of the reasons why I think that studying the case of science fiction can help throw light – from an unconventional source – on the reception and attitudes toward nuclear research and technologies in the Italian context. It also allows for an analysis of modernization processes in Italian history and of the relationship between cultural elites, decision-making processes and science laboratories, thereby contributing to a better understanding of the present state of scientific research and its relationship with public opinion and politics seen in an international (or, from the literary studies point of view, comparative) perspective.[9]

(Milano: Mimesis, 2015), esp. 21-98; Arielle Saiber, "Flying Saucers Would Never Land in Lucca: The Fiction of Italian Science Fiction", *California Italian Studies* 2 (2011): 1-47.

6 Carlo Pagetti, "Twenty-Five Years of Science Fiction Criticism in Italy (1953-1978)", *Science Fiction Studies* 6, no. 19 (1979): 320-26.

7 An examination of the theme across different media goes beyond the aims of the present essay, but awaits future research as a vast and promising field of enquiry. For the American context see Paul Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* 1985 (Chapel Hill: University of North Carolina Press, 1994); especially on the big screen see Maurizio Zinni, *Schermi radioattivi. L'America, Hollywood e l'incubo nucleare da Hiroshima alla crisi di Cuba* (Venezia: Marsilio, 2013); for the nuclear theme on English small screens see David Seed, "TV Docudrama and the Nuclear Subject", in *British Science Fiction Television: A Hitchhiker's Guide*, ed. John Cook and Peter Wright (London: Tauris, 2005), 154-73.

8 Patrick Parrinder, *Shadows of the Future: H.G. Wells, Science Fiction, and Prophecy* (Syracuse: Syracuse University Press, 1995), esp. 6-7; cf. Remo Ceserani, *Convergenze: Gli strumenti letterari e le altre discipline* (Milano: Bruno Mondadori, 2010) on the contributions of the literary discourse to other fields of knowledge.

9 Giovanni Paoloni, *Storia del nucleare in Italia tra passato e futuro*, roundtable moderated by Elisabetta Bini, *Next*, Trieste, Museo Revoltella, September 28, 2014, presentation.

Before World War II: Anglo-American Pioneers, between Enthusiasm and Fear

Before entering the realm of fantastic invention around nuclear technology in post-World War II Italy, it is worth mentioning the precursors of the theme within the national and international field of science fiction literature. The work done by Ernest Rutherford and Frederick Soddy on the spontaneous decay of uranium and radium clearly resonated, and greatly influenced scientific romances.[10] Radioactivity immediately became part of the stock-in-trade of science fiction, and led to all kinds of new gadgets and rays being dreamt up, from Robert Cromie's *The Crack of Doom* (1895), where the villain invented a way of unlocking the atomic energy contained in matter and threatened to destroy the world, to Garrett P. Serviss' *A Columbus of Space* (1911), featuring the first-ever appearance of an atomic-powered spaceship, to the atomic missiles in George Griffith's *The Lord of Labour* (1911). Not to mention the threat of an atomic holocaust in a work by H. G. Wells, the founding father of the genre: *The World Set Free* (1914), which also describes the discovery of atomic energy.[11]

As for the inventor of the very word *science-fiction*, Hugo Gernsback, "he had no hesitation in predicting its use as a power source in the near future, sometimes referring to the coming era of high technology as 'The Atom-Electronic Age' or 'The Age of Power-Freedom'";[12] and John W. Campbell Jr., another key figure in the history of the genre, the editor of the magazine *Astounding Science Fiction*, also wrote some of his first short stories around the power of the atom.[13]

To sum up the atomic presence in English-language science fiction during the 1940s, without going into a detailed survey, we can quote Brian Stableford: "After 1945, atomic power became one of the standard themes in science fiction, as the shock of revelation precipitated a wave of apocalyptic stories of the Holocaust (especially in the context of World War Three) and the Post-Holocaust aftermath. Mutational romance, popular since the mutagenic effects of X-rays had been discovered in the 1920s, also received a considerable boost".[14]

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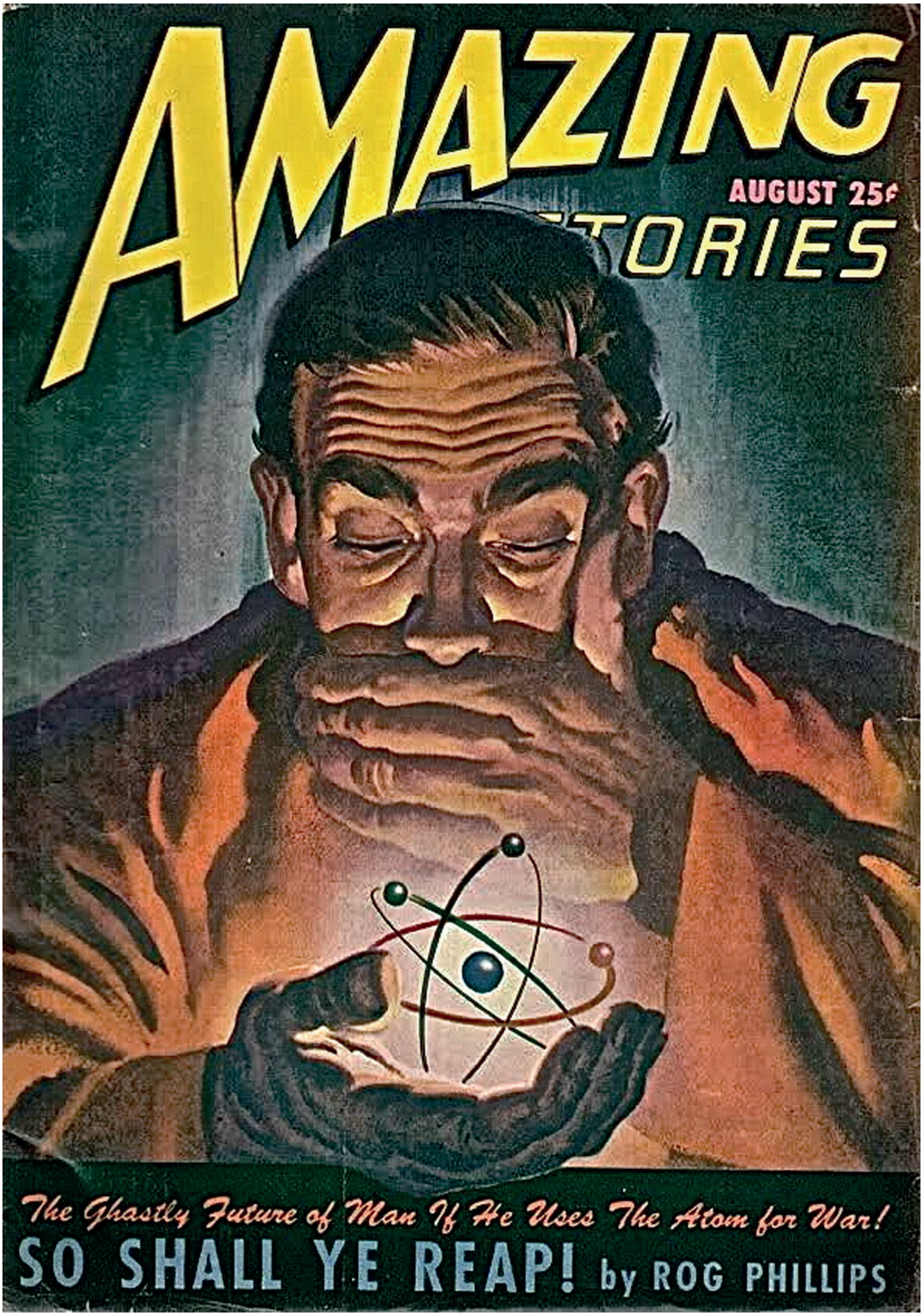
10 Brian M. Stableford, "Nuclear Energy", in *The Encyclopedia of Science Fiction*, ed. John Clute, David Langford, and Peter Nicholls, April 4, 2015, http://www.sf-encyclopedia.com/entry/nuclear_energy, last accessed May 6, 2016.

11 Parrinder, *Shadows*, 107.

12 Stableford, "Nuclear Energy".

13 For an overview on atomic technologies in American literary imagery see Boyer, *By the Bomb's Early Light*, part 7.

14 Stableford, "Nuclear Energy".



"The Ghostly Future of Man if He Uses the Atom for War!". Arnold Kohn's cover for the August 1947 issue of *Amazing Stories*.

As for the Italian precursors of the science fiction genre, in *L'anno 3000* (*The Year 3000*, 1897) by Paolo Mantegazza – a neurologist, physiologist, anthropologist, consultant and editor for Treves – there is significant concern about possible sources of energy for human activities, but the atom makes no appearance, and electricity in general is the (quite revolutionary enough!) source used to drive means of transport in place of coal or draught animals.

We have to wait for the dawning of the twentieth century to find the atom in the first fantastic adventures concerned with science and the future. In 1912, Yambo (aka Enrico Novelli), a prolific writer and illustrator of novels mainly for youngsters, wrote *L'atomo* (The Atom), set in the universe contained in an atom, with an invention non-related but parallel to Mark Twain's in *Three Thousand Years Among the Microbes* (1905).[15]

The 1950s: Promises of Modernity and Illegitimate Children

It was not until the early 1950s that science fiction arrived in Italy as a specific literary genre, and in fact the word *fanta-scienza* was coined in 1952 as a translation of the English term *science fiction*. The inventor of the word and of *Urania*, the first magazine ever to be presented in Italy as a specialized science fiction publication, was Giorgio Monicelli, love child of the journalist Tomaso Monicelli and the actress Elisa Severi, and nephew of the publishing tycoon Arnoldo Mondadori.

Some twelve years before the birth of Felice Ippolito's *Le Scienze*,[16] Mondadori agreed to Giorgio Monicelli's idea of starting a magazine on this "new" kind of fiction based on science that was popular in pulp magazines in the United States.[17] Interested in science as well as in mysterious archaeology, oriental philosophies, and futurology, Monicelli mostly featured translations of English and French authors in *Urania*, but he also began to foster an Italian "school" of science fiction authors. Among the (eleven) Italian novels published in the series under his editing (out of more than two hundred fifty issues, 1952-1961),[18] nuclear technologies made their appearance in more than one.

15 Federico Appel, "Mondi dentro mondi. Sull'uso della scienza nella letteratura per l'infanzia", *Libri e Riviste d'Italia* 1 (2007): 51-60.

16 Enrico Battifoglia, "La scienza raccontata dalle riviste divulgative italiane", in Treccani, Scuola, Dossier, April 14, 2011: n. p., http://www.treccani.it/scuola/dossier/2011/150anni_scienze/battifoglia.html, last accessed July 31, 2015.

17 Antonello, "La nascita"; Giulia Iannuzzi, "Giorgio Monicelli e l'alba della fantascienza in Italia", in *Officina del libri 2012*, ed. Lodovica Braida, Alberto Cadioli, and Edoardo Barbieri (Milano: Unicopli, 2013), 23-61; Iannuzzi, *Fantascienza italiana*, 23-42.

18 Iannuzzi, *Fantascienza italiana*, 43-57.

I Romanzi di Urania 1 (1952), cover by Curt Caesar.

Emilio Walesko's *L'atlantide svelata* (Atlantis Uncovered, 1954), presented in the blurb as the first Italian science fiction novel ever written, was the adventurous story of a fantastic voyage under the sea, made by the brilliant scientist Dr. Spargirus, and his younger companion, the engineer Satta.

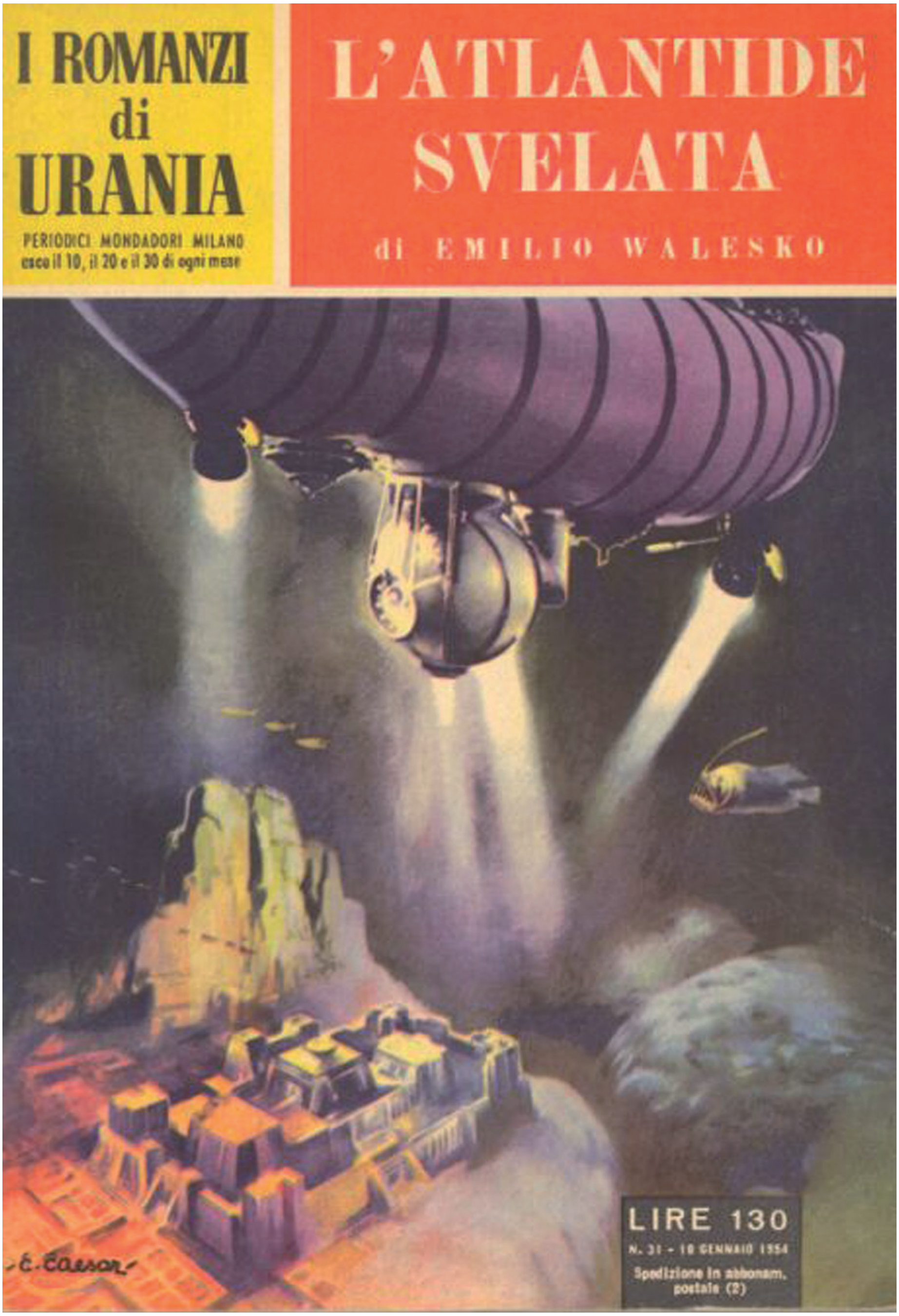
Aboard a bathyscaphe not dissimilar to the one used in Jules Verne's *Twenty Thousand Leagues under the Sea*, our two heroes discover the lost civilization of Atlantis in the depths of the ocean, portrayed as a techno-scientific utopia, in which mankind has harnessed the forces of nature thanks to his scientific knowledge and to the mastery of incredibly advanced technologies. The source of power on Atlantis is nuclear energy.

> [the Atlantis scientist to Spargirus -] The water that took everything from us [during the ancient flood that destroyed the first Atlantis on the Earth's surface], now gives us everything we need to survive. It provides the oxygen to breathe, and the hydrogen necessary for nuclear reactions; and these give us heat and electricity. The hydrogen is, moreover, our primary raw material, from which we obtain all the others. We have 5 thermoelectric stations, differently deployed and autonomous, all connected to the same grid ...
> I know you for an expert in atomic energy and we know that your machine is powered by an atomic reactor. Which technology are you using?
> [Spargirus -] Heavy water.
> [the Atlantis scientist -] It is still a good technology, but we used it many years ago, and now it has been completely abandoned.
> [Spargirus -] How many years ago?
> [the Atlantis scientist -] I don't remember exactly, but at least 600 years ago.
> [Spargirus -] And now?
> [the Atlantis scientist -] We bombard the hydrogen, we bring about the same transformation cycle as that of the Sun, it's the cycle you call – if I am not mistaken – the Bethe cycle. It's simple and economical: nature herself has suggested it …[19]

The same fascination for nuclear technologies as the promising energy source of the future is to be found in *Organizzazione Everest* (Everest Organization, 1958) written by Maria Teresa Maglione under the pseudonym Esther Scott.[20] The protagonist – a young mechanic – is recruited by a secret organization whose mission is to reconcile the Eastern and Western blocs, by faking the existence of an extra-terrestrial threat. The organization headquarters are located inside the Everest range and logistically and administratively structured as a modern scientific utopia: the researchers' code of conduct sounds like a small-scale version of the Universal Declaration of Human Rights, the small society has

19 Emilio Walesko, *L'atlantide svelata*, *I Romanzi di Urania* 31 (1954), 71-72. Translations are mine unless otherwise indicated.

20 Esther Scott [Maria Teresa Maglione], *Organizzazione Everest*, *I Romanzi di Urania* 192 (1958).



Emilio Walesko, *L'atlantide svelata*, *I Romanzi di Urania* 31 (1954), cover by Curt Caesar.

an egalitarian and socialist-like constitution. Atomic power plants, along with electronic calculators, are the technological basis of the advanced scientific research conducted by the Organization, to reach new frontiers of knowledge and technology (including human space flight).

A case in point with a different attitude, one offering an early example of atomic fear in Italian science fiction is *C'era una volta un pianeta...* (Once there was a Planet..., 1954), written by Luigi Rapuzzi – a writer and painter from Udine – under the pseudonym of Louis R. Johannis.[21] The novel is set in a remote past and gives a fantastic and tragic explanation of the asteroid belt located between Mars and Jupiter. A planet used to be there, inhabited by an advanced species, but it was blown up in a nuclear war; the few survivors of the catastrophe landed on Earth and after mating with the Neanderthals, started the human race as we know it (a story narrated in the sequel: *Quando ero "aborigeno"* – When I Was an Aborigine, 1955).[22]

Alongside these expressions of the science fiction genre, we must mention another side of the relationship between Italian humanistic culture and the nuclear issue: the extraordinary experience of an intellectual such as Leonardo Sinisgalli and his *Civiltà delle Macchine* (The Civilization of Machines), a journal published by the industrial group Finmeccanica and edited by Sinisgalli between 1953 and 1958. This publication was one of the most interesting attempts made in those years by Italian industrialists to have a cultural organ of their own, and was a fascinating laboratory for dialogues between the "two cultures" (in 1965, it would also feature reflections on the debate about Snow's *Two Cultures*).[23] It is no coincidence that Sinisgalli was asked to collaborate first in *Pirelli* and then in *Civiltà delle macchine* by Giuseppe Eugenio Luraghi, another exceptional figure in the Italy of these years, who graduated from Bocconi University, worked for the Pirelli tyre company and enjoyed a long career from then on, eventually becoming managing director of the car industry Alfa Romeo.[24]

Called early on by the physicists of via Panisperna, Sinisgalli preferred to study industrial engineering (1932), but he would remain receptive and interested in Enrico Fermi's school and in nuclear technologies: he commissioned various articles on the via Panisperna group and its protagonists, on nuclear energy and fallout scenarios, featured between 1953 and 1956.[25] The study of protagonists such as Fermi and Robert

21 Louis R. Johannis [Luigi Rapuzzi], *C'era una volta un pianeta...*, *I Romanzi di Urania* 41 (1954).

22 Louis R. Johannis [Luigi Rapuzzi], *Quando ero "aborigeno"*, *I Romanzi di Urania* 110 (1955).

23 Antonello, *Il Menage*, 17n1.

24 Gian Carlo Ferretti and Giulia Iannuzzi, *Storie di uomini e libri. L'editoria letteraria italiana attraverso le sue collane* (Roma: minimum fax, 2014), 115-18.

25 Antonello, *Il Menage*, 154, 166n108, 166n109; Antonello, "'How I learned to stop worrying and love the bomb': Minaccia nucleare, apocalisse e tecnocritica nella cultura italiana del secondo Novecento",

Civiltà delle macchine 1, no. 1 (1953), cover: *Il volo degli uccelli di Leonardo da Vinci.*

Oppenheimer without ostracism, and the reasoning about the splitting of the atom as part of the cognitive adventure of human kind, takes the issue of a nuclear catastrophe to a non-eschatological level, which is especially significant given what would happen in the years to come.

All in all, during the reconstruction years, despite the chronological proximity of Hiroshima and Nagasaki, atomic power was not considered negatively by some Italian intellectuals, being part of a broader optimism, enthusiasm and emphasis on its emancipative potential.[26]

The 1960s and 1970s: Malaise of Modernity and the Nuclear Menace

The 1960s and 1970s were characterized by a vast outpouring of narrations and discourses about the nuclear threat in Italy. During these years, the nuclear theme became an excellent observatory, a synecdoche, we might say, of the relationship between Italian intellectuals and techno-science.[27]

Let us start with a famous, paradigmatic example of non-fiction: the public speech "Pro o contro la bomba atomica" ("For or Against the Atom Bomb") presented on various occasions and published by the (non-science fiction) writer Elsa Morante in 1965. The pamphlet is worth quoting, for it is a brilliant example of many of the crucial issues of Italian culture of that time:

> There is no doubt that the most important element in our present – the thing that nobody can ignore, is this: that we, inhabitants of the *civilized* twentieth-century nations, live in the age of the atomic bomb. And in fact, everybody knows this: the adjective *atomic* is repeated on every occasion, even in jokes and in popular magazines. ...

The Italianist 33, no. 1 (February 2013): 89-119, esp. 92-93. The series includes: U. Maraldi, "Avventura nello spazio e nel tempo", *Pirelli* 4 (1952): 16-17 (portrait of Fantappié); G. De Chiara, "Un pioniere delle esperienze nucleari", *Pirelli* 3 (1951): 8-11 (portrait of Amaldi); Amaldi, "Fisica e ingegneria nucleare", *Pirelli* 3 (1951): 10-11; Vittoria Notari, "Via Panisperna culla dell'atomica", *Civiltà delle Macchine* 2 (1953): 40-42; Aldo Persano, "Ancora tre anni per la pila atomica italiana?", *Civiltà delle Macchine* 3 (1953): 12-14; L. De Broglie, "Conseguenze biofisiche delle esplosioni atomiche", *Civiltà delle Macchine* 1 (1955): 51; V. Razzi, "Via Panisperna e la preistoria dell'atomica", *Civiltà delle Macchine* 5 (1956): 40-47.

26 See the fundamental Antonello "'How I Learned'", esp. 92 and *passim*, for the idea of a "nuclear" or "apocalyptic reductionism" (*riduttivismo apocalittico*) in relation to Sinisgalli's *Civiltà delle Macchine* of these years, and coeval short stories by Pietro Calamandrei and Dino Buzzati; see esp. 96-97 on Enrico Baj and Sergio Dangelo's *pittura nucleare* (nuclear painting).

27 On the Atomic bomb as an object of cultural *transfer* see Antonello "'How I Learned'".

Elsa Morante, *Pro e contro la bomba atomica e altri scritti* (Milano: Adelphi, 1987). Graphic design elaborated on 1895 maquette by Aubrey Beardsley.

> But why is it that a fundamental secret of nature (perhaps *the* secret of nature), already intuited by man since ancient times in different places and ages, by advanced civilizations eager for knowledge, has only in the present day and age been verified, been physically rediscovered? It is not enough to say that during the great adventure of the human mind, the seduction of science has replaced that of the imagination: while this might sound like an answer, it is actually more of a question, which makes the problem even more demanding. But nobody is going to believe that this was a coincidence; that the human world reached this crucial crisis simply because at a certain point, human intelligence, always in search of new adventures, followed one dark path among other dark paths, and that along the way, its sorcerer-scientists just happened to discover the secret.[28]

The mention of nuclear power is noteworthy as *the* supreme secret of nature, but only in reference to the atom bomb threat (with no mention of the civilian uses of nuclear technology in the rest of the essay either), as well as the sharp distinction and contraposition with clear axiological implications of *imagination* and *science*. What is more, the term "sorcerer-scientists" ("stregoni-scienziati" in Italian) effectively conveys an idea of radical strangeness and lack of understanding, as well as – together with the reference to the "dark paths" of scientific enquiry – throwing an ominous, negative light on the very idea of scientific research, rhetorically but also conceptually flattened on the possible destructive uses of certain technical discoveries. Thus, nuclear technology, identified with *the bomb*, becomes a symbol of the nihilism of the contemporary age whose destructive power was prefigured in the concentration camps: "the atomic bomb is the flower, the natural expression of our society, just as Plato's dialogues were that of Greek civilization, and the Colosseum that of imperial Rome's … and the concentration camps that of a petty bourgeois, bureaucratic culture already infected by the anger of atomic suicide".[29]

It is also interesting how during these years (as I will return to later on) the theme of nuclear catastrophe often becomes the vehicle for writers' reflections on their social role, function and engagement. It therefore comes as no surprise, a few pages further on, to hear Morante saying: "And at times the writer will feel like telling everyone to go to the devil, with their cheap magazines, their singer-songwriters, and their cyclotron",[30] in a very revealing simultaneous condemnation of the technology used to accelerate subatomic particles and those new expressions of mass culture ever more common in Italy after the economic miracle.

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28 Elsa Morante, "Pro e contro la bomba atomica" (1965), in Morante, *Pro e contro la bomba atomica e altri scritti* (Milano: Adelphi, 1987), 97-117, qt. 97, 98.

29 Morante, "Pro e contro", 99.

30 Morante, "Pro e contro", 105.

A similar association between novels treating the nuclear catastrophe and reflections on contemporary society is found in cases such as Guido Morselli's *Dissipatio HG* (1977), Antonio Porta (Leo Paolazzi)'s *Il re del magazzino* (The King of the Storeroom, 1978), and Paolo Volponi's *Il pianeta irritabile* (Irritable Planet, 1978). In the texts and para-texts of these novels (within the narration or in the authors' introductions, auto-comments, interviews) we find significant statements, on the part of the authors, distancing their works from the science fiction genre, such as can also be found in the writings of Primo Levi and Italo Calvino.[31] In these authors, at one and the same time, the "discomfort of modernity" takes the form of the nuclear bomb threat as a theme (or, in Morselli's case, the idea of a disappearance of the human race not explicitly nuclear but still ascribable to the terror of a nuclear world war) and the disapproval of science fiction as a popular, cheap genre.

We can read in a similar sense the dissemination of nuclear threats in many other narratives written during the years of the economic boom:[32] from the atomic bombs that in Dino Buzzati's short stories (e.g. "Pusillanime" – Coward, 1950; "Rigoletto", 1954; "All'idrogeno" – With hydrogen, 1954) threaten individual characters, as a metaphorical incarnation of man's uncertain destiny and of death itself; to the moral and moralistic use of the atomic catastrophe in Carlo Cassola's *Il superstite* (The survivor, 1978); to the obsession appointed on physical mutation of the protagonist in Paolo Volponi's *Corporale* (Corporal, 1974).[33] In all these narratives the nuclear catastrophe is never directly the object of the representation (or we find it only in distant, marginal, fleeting visions): we are always on the verge of the explosion, or we see the world right after. Quite far from any spectacularization, the main interest of these authors is located in a moral or

31 For a close reading of these *loci* see Florian Mussgnug, "Finire il mondo. Per un'analisi del romanzo apocalittico italiano degli anni settanta", *Contemporanea* 1 (2003): 19-32, esp. 22-23; for the relationship of Calvino's work with science fiction and the scholarship attitude within and outside Italy see Elio Baldi, "Science Fiction and the Canon: the Case of Italo Calvino", *ReadingItaly* 3 (June 2014), https://readingitaly.wordpress.com/2014/06/03/science-fiction-voices/, last accessed May 23, 2016; Baldi, "Italo Calvino and Science Fiction: A Little Explored Reading", in *Calvino's Combinational Creativity*, ed. Elizabeth Scheiber (Newcastle upon Tyne: Cambridge Scholars Publishing, 2016), 41-61. On Morselli's *Dissipation HG*, Volponi's *Pianeta irritabile* and Cassola's "nuclear trilogy" (*Il superstite*, *Ferragosto di morte*, *Il mondo senza nessuno*) see Bruno Pischedda, *La grande sera del mondo. Romanzi apocalittici nell'Italia del benessere* (Torino: Aragno, 2004).

32 Stefano Lazzarin, "Atomiche all'italiana. Il tema della catastrofe nucleare nella fantascienza italiana d'autore (1950-1978)", *Testo* 31, no. 59 (2010): 97-115.

33 The presence of mutants in Italian science fiction narratives of this period would require an essay for itself. We can point out here that the theme of physical mutation, of corporal deformity became an effective metaphor for (and extrapolative prosecution of) real discriminations of another kind, in effective works such as Vittorio Curtoni's "Ritratto del figlio" ("Portrait of the Son"), 1970, and *Dove stiamo volando* (Where Are We Flying), 1972.

existentialist dimension of critical reflection, hence also the emphasis on the stories of single individuals, and the obliteration of the collective dimension of the catastrophe: the masses are a great absence here, a void left by the nuclear holocaust. Especially *Corporale*, with a quote from "Pro o contro la bomba atomica" as an epigraph, and a mutation that actually takes place *before* any bomb and nuclear fallout, aptly exemplifies how the atomic theme has been almost "naturally" employed as the correlative object of an anthropological mutation, of the socio-economic and cultural changes that the Italy of those years was undergoing[34] and of a pronounced mistrust and estrangement toward the new centrality that techno-science was acquiring in society and culture, of which the bomb was, for these writers, the epitome.

Along with others, Antonello reads nuclear anxiety as a reaction to the effects of the economic miracle (among which we shall include the appearance and success of popular publications and the translation of Anglo-American science fiction): in Italy during these years, the thematization of the nuclear catastrophe neatly overlaps with the thematization of the neurosis, and with a resulting "literature of a 'projective' nature, not so much interested in examining the issues and questions raised by the Cold War or the nuclear threat by looking at the facts, as in using them as negative fetishes, around which collective fears can be made to converge, along with conceptual oversimplifications of an ideological nature".[35]

Another interesting case, appearing exactly ten years after Morante's essay, is Leonardo Sciascia's novel *La scomparsa di Majorana* (The Disappearance of Majorana, 1975): a reconstruction and narration of the last years of Ettore Majorana, an Italian physicist who disappeared mysteriously. The novel takes the form of an inquiry (*romanzo inchiesta*) which, while using various sources, including Fermi's *Atomi in famiglia* (Atoms in the Family, 1954) and Amaldi's *Nota biografica di Ettore Majorana* (Ettore Majorana biographical note, 1966), essentially leaves us with the idea of a scientist who by disappearing has abdicated his role and responsibilities toward society.[36]

34 Emanuele Zinato, "Commenti e apparati critico-filologici", in Paolo Volponi, *Romanzi e prose*, vol. 1 (Torino: Einaudi, 2000), 1157; and Lazzarin, "Atomiche all'italiana"; cf. also Antonello, *Contro il materialismo*, 233-34; Romano Luperini, *Il Novecento* (Torino: Loescher, 1981), 815.

35 Pierpaolo Antonello, "Letteratura e scienza", in *Storia d'Italia*, annali 26, *Scienze e cultura dell'Italia unita*, ed. Francesco Cassata and Claudio Pogliano (Torino: Einaudi, 2011), 923-48, qt. 941.

36 Antonello, "Letteratura e scienza", 942; Arnaldo Bruni, "La scomparsa di Majorana", *Sciascia, scrittore europeo: Atti del Convegno internazionale di Ascona*, ed. Michelangelo Picone, Pietro DeMarchi, and Tatiana Crivelli (Basel: Birkhäuser, 1994), 181-207.

I would like to conclude on a more playful note by returning to the issue of condemnation of science fiction as a symptom of Italian intellectuals' "malaise of modernity": the following quote is taken from an article by Giorgio Manganelli, written to mark the 1977 release of George Lucas' blockbuster movie, *Star Wars*:

> I would like to pay a tribute to that third-rate, childish, noisy, and demented genre called *fantascienza* [science fiction], with a nearly-Italian expression. Science fiction has – correctly – been said to be a symptom of schizophrenia, a never-ending, rubbishy proliferation of maniacal sewage, that satisfies our thirst for madness. True, quite true, and that is precisely why I would like to pay tribute to it. Rough, primitive, repetitive, just like dementia, and – we might add – like death itself.
> [... *Star Wars*] I know, it's a movie that children like: those little monsters that are already practicing at pushing the good buttons of Megadeath.[37]

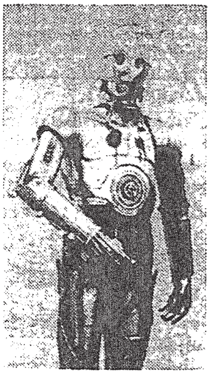
A "review" highly indicative of the extent to which the visual media, together with literature, were influencing how the genre was received (as well as its success) and also the degree to which Italian intellectuals' attitude toward the genre was characterized by a sense of alienation from techno-science, which was ultimately to become another example of widespread nuclear psychosis.

37 Giorgio Manganelli, "L'oroscopo? No, meglio 'Guerre stellari'", *Corriere della Sera* November 10, 1977: 3.

OMAGGIO ALLA FANTASCIENZA, LETTERATURA ANALFABETA

L'oroscopo? No, meglio «Guerre stellari»

Vorrei rendere omaggio a quel genere letterario infimo, infantile, fracassone e demente che in quasi italiano si chiama fantascienza. E' stato detto, del tutto a ragione, che la fantascienza è sintomo di schizofrenia, che è una infinita ed infima proliferazione di liquami maniacali, che sfama la nostra fame di follia. Vero, verissimo; ed appunto per questo intendo renderle omaggio. Rozza, elementare, ripetitiva, appunto come la demenza e, possiamo aggiungere, come la morte. In un tempo in cui l'ottimismo riposa su un ingegnoso sistema di lapsus, scotomi, dimenticanze ed omissioni, la fantascienza parla di qualcosa che tutti gli esseri umani mediamente ragionevoli hanno in mente: parla delle Apocalisse.



Questa brutta letteratura mi porta alla mente quegli opuscoli fogli e volantini che al tempo della Riforma parlavano agli incolti della fine del mondo, dell'ultimo giudizio, dei novissimi. Difficilmente la paura è sottile, colta, smaliziata; e tuttavia vuole essere detta. Se dentro di noi esiste un nodo di paura impazzita, vorrà sciogliersi in una ~~prosa,~~ in una fantasia sgangherate e terrifiche. La fantascienza nasce da una brutta sofferenza, dalla coscienza che mai come adesso noi siamo stati sottratti a noi stessi, che noi viviamo in un tempo in cui generali linguisti, che non leggono fantascienza, hanno coniato la bella — veramente bella — parola Megadeath, Megamorte, per coprire di un lieve velo di plastica un milione di morti, un milione di noi, di io.

Non dimentichiamo che la fantascienza parla di stelle: è, dunque, questa letteratura analfabeta, quello che resta, o quel che l'angoscia ci ha restituito, di senso del cosmo. Si possono preferire gli oroscopi settimanali che preannunciano inaudite imprese sessuali e lievi disagi serali ai nati in Ariete. Preferisco lo sconcio delirio di chi balbetta di accumulatori teomorfi nel centro del mondo, di Principi del Male che pilotano astronavi nell'iperspazio.

Non credo che il successo attuale di un film come « Guerre stellari » derivi dal fatto che si tratta di un racconto irreale, di fuga, di evasione. Incidentalmente, la letteratura di evasione allude alla galera. « Guerre stellari » è rozzo e raffinato, fantasioso e monotono, sottile ed elementare: quell'incredibile miscela di mirabili mostri, modellini omicidi, e subliminari messaggi tra medievali ed orientali, ne fanno un film ruvidamente centrale, che farfuglia di tutto, come un matto che ha assistito ad un delitto ed è il solo che sa ma non può dire.

Lo so: è un film che piace ai bambini, questi mostriciattoli che già si allenano a premere i buoni bottoni della megamorte. E' probabile che faccia pregustare la pace del decesso ai nonni che si sobbarcano la vigilanza degli spazionipoti. E tuttavia, rozzo e stremante, questo film in qualche modo agisce. Decomposto, degradato, appena riconoscibile nella sua deformità, esso nasconde sotto il fragore delle macchine un accenno alla scienza zen del tiro con l'arco, perfino dei brandelli di tao.

Sarebbe temerario affermare che tutto ciò rappresenti un messaggio filosofico o comunque intellettuale. Ma questo incuriosisce, che tanto spesso la schizofrenica letteratura fantascientifica alluda in modo infimo a concetti drammaticamente sottili. Lo so, in America c'è la California, ci sono tutte le sciocchierie e le qualunquaggini mezzorientali che sappiamo; ma oserei dire che in fatto di qualunquaggini non abbiamo gran che da imparare, e che resta vero che, purché deformate e sfregiate, certe immagini del mondo riescono a pervenire. Il momento in cui colui che vuol colpire il bersaglio deve rinunciare a sapere dove si trova, deve « non prendere la mira », racchiude il fascino fastidioso e irruente del paradosso.

Grandi schermi deflettori, per parlare il linguaggio stellare, difendono il nostro cervello dall'insidia acuminata del paradosso, di quell'attimo in cui il linguaggio presenta a noi il suo rovescio, in cui il tappeto del mondo rivela i nodi che presiedono ai suoi disegni più sottili. D'accordo, esagero: ma anche « Guerre stellari » esagera, e non sempre a torto.

Giorgio Manganelli

Giorgio, Manganelli, "L'oroscopo? No, meglio 'Guerre stellari'", *Corriere della Sera* November 10, 1977: 3.

Renato Moro

Against the Euromissiles: Anti-nuclear Movements in 1980s Italy (1979-1984)*

Between 1981 and 1983, mass mobilization against nuclear weapons represented an extraordinary novelty in Italian history. However, scholars have largely overlooked this topic.[1] Through a study of primary sources, this chapter analyzes this issue by examin-

* This essay is one of the outcomes of the 2008 Progetto di Rilevante Interesse Nazionale (PRIN), *All'ombra della bomba. Una storia politica delle applicazioni civili e militari dell'energia nucleare*. Its main results were presented at a conference held in Cagliari on November 7-10, 2012.

1 In the wake of the movement much (including scholarly) interest arose. See in particular, Pierangelo Isernia, "I movimenti per la pace: una realtà in divenire", *Il Mulino* 286 (1983): 233-58; Giovanni Lodi, *Uniti e diversi. Le mobilitazioni per la pace nell'Italia degli anni '80* (Milano: Edizioni Unicopli, 1984); Sergio A. Rossi and Virgilio Ilari, "The Peace Movement in Italy", in *The Peace Movements in Europe and the United States*, ed. Werner Kaltefleiter and Robert L. Pfaltzgraff (London: Croom Helm, 1985), 140-61; Ada Ferrari, "Il pacifismo contemporaneo fra idea nazionale e idea planetaria", *Storia contemporanea* 5 (1986): 889-901; Virgilio Ilari, "Storia politica del movimento pacifista in Italia", in *Sicurezza e difesa. Fattori interni e internazionali*, ed. Carlo Jean (Milano: FrancoAngeli, 1986), 231-89; Centro Militare di Studi Strategici, *Rapporto di ricerca su i movimenti pacifisti e antinucleari in Italia, 1980-1988* (Roma: Rivista militare, 1990). In the following years, only a few, and not always accurate, sociological studies were published: Carlo Ruzza, "Institutional Actors and the Italian Peace Movement: Specializing and Branching out", *Theory and Society* 1 (1997): 87-127; Simone Tosi and Tommaso Vitale, "Explaining How Political Culture Changes: Catholic Activism and the Secular Left in Italian Peace Movement", *Social Movement Studies* 8, no. 2 (2009): 131-47. Studies of Italian pacifism are either too partisan or too perfunctory: Antonella Marrone and Piero Sansonetti, *Né un uomo né un soldo: una cronaca del pacifismo italiano del Novecento* (Milano: Baldini Castoldi Dalai, 2003); Pietro Pàstena, *Breve storia del pacifismo in Italia. Dal Settecento alle guerre del terzo millennio* (Acireale: Bonanno, 2005); Amoreno Martellini, *Fiori nei cannoni. Nonviolenza e antimilitarismo nell'Italia del Novecento* (Roma: Donzelli, 2006); Gabriella Mecucci, *Le ambiguità del pacifismo. Luci e ombre di un movimento nato dalla Perugia-Assisi* (Argelato: Minerva, 2011). More recently, a series of well-documented articles have been published, but they have not really filled the gap. These include two groundbreaking contributions, such as Giovanni Mario Ceci, "'Pace nella sicurezza' o 'sicurezza nella pace'. Il mondo cattolico italiano e la Democrazia cristiana di fronte alla sfida degli euromissili", *Mondo contemporaneo* 1, no. 2 (2005): 71-75; and Valentine Lomellini, "La fine di un'egemonia? Il PCI, il movimento per la pace e la genesi di nuove identità politiche nell'Italia degli anni Ottanta", in *Dal Sessantotto al crollo del Muro. I movimenti di protesta in Europa a cavallo tra i due blocchi*, ed. Valentine Lomellini and Antonio Varsori (Milano: FrancoAngeli, 2014), 127-15; some useful essays, which, however are not devoted to the

ing the origins of the movement between 1979 and 1981 and its main features (first paragraph), the divisions that characterized it, as they emerged at its first gathering in November 1981 (second paragraph), its evolution and inner contrasts between 1982 and 1984 (third paragraph), and it will end with a final appraisal (fourth paragraph).

The Birth of the Movement (1979-1981)

In the post-World War II period, Italy lacked a strong independent peace movement and the only mass mobilization for peace Italians had experienced was the Communist one.[2] In 1976-1977, a movement against civilian uses of nuclear energy emerged, but it entered a sudden crisis.[3] In 1977 and 1978, a mass protest against the neutron bomb failed to arise, probably because the country was facing other more arduous issues.[4] Therefore, it is not surprising that in Italy an anti-nuclear weapons movement started much later than in countries such as the United Kingdom, Germany or the Netherlands, and that it was marked from the beginning by a form of politicization unknown elsewhere. This was due to the role Communists and youth movements belonging to

protests: Guido Formigoni, "La DC e il dibattito sulla pace nel mondo cattolico postconciliare", in *Le sfide della pace. Istituzioni, movimenti intellettuali e politici tra Otto e Novecento*, ed. Alfredo Canavero, Guido Formigoni, and Giorgio Vecchio (Milano: LED, 2008), 231-48; Paolo Pellizzari, "Socialisti e comunisti italiani di fronte alla questione energetico-nucleare 1973-1987", *Italia contemporanea* 259 (2010): 237-61; Matthew Evangelista, 'Atomic Ambivalence: Italy's Evolving Attitude towards Nuclear Weapons', in *Italy's Foreign Policy in the Twenty-First Century: The New Assertiveness of an Aspiring Middle Power*, ed. Giampiero Giacomello and Bertjan Verbeek (Lanham: Lexington Books, 2011), 115-34; Gregorio Sorgonà, "Gli euromissili e il Msi. Il neofascismo italiano e la sua area giovanile di fronte al rilancio della Guerra fredda 1979-1983", *Italia contemporanea* 276 (2014): 476-500. The few articles focusing on the anti-nuclear movement are usually disappointing. In some cases, they are incomplete from the point of view of the sources, or they offer an interpretation that is completely internal to the movement. This is the case with Alessandro Santagata, "'Invece dei missili'. I cattolici e la 'profezia' della pace: dalla campagna per il Vietnam alla protesta di Comiso', *Italia contemporanea* 276 (2014): 423-47. In other cases, they are written in haste, as is the case with Marco Bizzoni, "L'iniziativa del PCI contro gli euromissili", *Giornale di storia contemporanea* 15, no. 1 (2011): 91-101. Still in other cases, they are or too local in approach, as is the case with Antonio Baglio and Vincenzo Schirripa, "'Tutti a Comiso'. La lotta contro gli euromissili in Italia 1981-1983", *Italia contemporanea* 276 (2014): 448-75.

2 Anna Scarantino, "Tra 'organizzazione', 'cultura' e 'lotta' per la pace. Il pacifismo italiano negli anni della guerra fredda", *Giornale di storia contemporanea* 12, no. 2 (2009): 141-78.

3 Simone Neri Serneri, "Culture e politiche del movimento ambientalista", in *L'Italia repubblicana nella crisi degli anni settanta. II – Culture, nuovi soggetti, identità*, ed. Fiamma Lussana and Giacomo Marramao (Soveria Mannelli: Rubbettino, 2003), 367-99, see 381-82.

4 See for instance "La grande equiparatrice. Le polemiche sulla bomba N", *Lotta continua*, April 16-17, 1978, 11.

the different groups of the "New Left" had in transforming the anti-nuclear issue into a battlefield for continual political struggles.

The first political parties to oppose a possible Italian government decision, in September and at the beginning of October 1979, were the Partito Radicale (PR)[5] and the Partito di Unità Proletaria (PDUP).[6] At the end of October, grassroots Catholic groups, in an evident contraposition to the Catholic majority party, the Democrazia Cristiana (DC), proposed the creation of a large, ethically based protest mass movement: a sort of "disarmament party".[7] On October 31, and then again on December 2, many Catholic movements and associations (including Azione Cattolica) presented an appeal to promote negotiations and refuse any "nuclear rearmament strategy".[8] However, it was especially the Partito Comunista Italiano (PCI) that was active on this issue. As the Communist press put it, "it is a matter of implementing a strong united array".[9] Hence, at the beginning of December, Communists organized hundreds of mass gatherings throughout the country,[10] following a series of strategies and procedures that drew on (explicitly) classical, well-rehearsed, past models introduced by the Partigiani della Pace,[11] such as appeals by intellectuals[12] and the mobilization of students and women.[13] However, even though the PCI acted in an extremely cautious way, avoiding "obviously one-sided anti-Western positions" as a Central Intelligence Agency (CIA) report noted,[14] it did not succeed in drawing other major parties (neither the DC nor the Partito Socialista Italiano, PSI) to the peace movement.[15]

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5 Atti Parlamentari, Camera dei Deputati, VIII Legislatura – Discussioni, Seduta del 21 settembre 1979, 1831-32, and Seduta del 26 ottobre 1979, 3459.

6 Atti Parlamentari, Camera dei Deputati, VIII Legislatura – Discussioni, Seduta del 10 ottobre 1979, 2610.

7 Arrigo Bongiorno, "Euromissili e 'partito del disarmo'", *Avvenire*, October 28, 1979, 15, qt. in Ceci, "'Pace nella sicurezza'", 71.

8 "I missili non preparano la pace", *Avvenire*, October 31, 1979, 1 and "La verità è la forza della pace", *Avvenire*, December 2, 1979, 3.

9 "Lunedì il corteo dall'Esedra per la pace e la distensione", *l'Unità*, December 1, 1979, 11.

10 "Contro la rincorsa ai missili nucleari in Europa. Migliaia manifestano nelle strade di Modena'", *l'Unità*, December 1, 1979, 17 and "'Con i missili la guerra è più vicina: diciamo di no'", *l'Unità*, December 12, 1979, 4.

11 "Con una grande fiaccolata scende di nuovo in piazza un movimento che vuole la pace", *l'Unità*, December 4, 1979, 8.

12 "Intellettuali contro la corsa al riarmo", *l'Unità*, December 9, 1979, 12; and "Stasera tutti in piazza per la pace. Il significato di una mobilitazione unitaria e spontanea", *l'Unità*, December 14, 1979, 10.

13 "'Con i missili'".

14 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, National Archives and Records Administration, Washington, DC (hereafter NARA), Freedom of Information Act, Electronic Reading Room (hereafter FOIA), Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489.

15 "Il discorso di Berlinguer a Firenze", *l'Unità*, February 18, 1980, 2.

When, in April 1980, European Nuclear Disarmament (END) appealed to its "European friends" to create a common movement against missiles, Italians failed to react. They did so only in the second half of 1981, when a series of changes transformed people's attitudes: a major turn in US policies, following the election of Ronald Reagan to the White House (and especially the announcement that the United States would develop the neutron bomb);[16] the selection on the part of the Italian government of the small Sicilian town of Comiso for the installment of cruise missiles;[17] the air fighting in the Gulf of Sidra that abruptly evoked the specter of war just a few miles off the Italian shores;[18] the growth of a mass protest movement in northern Europe in which the main Socialist parties took part.[19] On September 1981, the Movimento Nonviolento (again close to the PR) launched an appeal for a new edition of the Perugia-Assisi peace march. The slogan they used was: "Against the war: it is up to everyone to do something". On September 27, 60,000 people participated in the march (from the PCI, the PDUP, Democrazia Proletaria, the PR, various antimilitarist and nonviolent groups, Evangelicals and Catholics, and even Socialists in contrast with the PSI's official position).[20] According to philosopher Norberto Bobbio, public opinion was exhibiting "its anguish, fears, wills".[21]

The first major meeting of the movement took place in Rome on October 24 and was promoted by a Coordinating Committee formed by young members of the PCI and New Left activists.[22] Participation went beyond the most optimistic expectations: 300,000 people attended (200,000, according to the CIA).[23] The Turin newspaper, *La Stampa*, wrote: "It is not since the metalworkers' demonstration in 1969 that the capital has seen so many people parading through its streets".[24] Another aspect the press high-

16 "Bomba N: 'decisione americana'. Il via alla sua fabbricazione", *Avanti!*, August 11, 1981, 1, 8; "Bomba N: l'Urss mette in forse il negoziato sugli euromissili. Reagan difende la scelta della bomba N'", *Avanti!*, August 12, 1981, 1, 8; Mary Onori, "Con il 'piano Weinberger' Reagan decide la svolta militare", *l'Unità*, August 18, 1981, 1, 12.

17 Sergio Baccelli and Ovidio Della Croce, "Il risveglio del movimento pacifista in Europa", *Politica internazionale* 10, no. 6 (1982): 108-23, see 113.

18 Paolo Gentiloni, Alberto Spampinato, and Agostino Spataro, "Pio La Torre, i missili, il movimento pacifista", in *Missili e Mafia. La Sicilia dopo Comiso*, ed. Gentiloni, Spampinato, and Spataro (Roma: Editori Riuniti, 1985), 69-77.

19 Luciano De Pascalis, "Mentre si intensifica la corsa al riarmo cresce nei popoli la volontà di pace", *Avanti!*, August 18, 1981, 6.

20 Ruggero Conteduca, "Ad Assisi, in 50 mila 'Il mondo vuole pace'", *La Stampa*, September 28, 1981, 1, 2.

21 Eugenio Manca, "Bobbio: tragica scalata che la gente può fermare", *l'Unità*, September 29, 1981, 1.

22 Baccelli and Della Croce, "Il risveglio", 113.

23 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, NARA, FOIA, Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489.

24 Marco Tosatti, "Roma, imponente sfilata per la pace 'Vietate' le ambasciate Usa e Urss", *La Stampa*, October 25, 1981, 5.

lighted was the fact that this impressive mobilization was characterized by two different – and at times contrasting – groups: on one side, the Communists and their allies, on the other side, youth movements.[25] Lacking trade unions' support, the movement drew its strength from young and left-wing activists. In the second half of the 1970s, reduced participation in student movements and New Left groups created a situation that can be defined, using Alessandro Pizzorno's words,[26] of "militancy excess". In other words, there were now many young activists eager to participate in anti-missiles protest. However, this double origin of the mobilization was characterized by a contradiction (and a consequent political problem, which proved difficult to overcome) between Communist mass organizations, with their "united front" strategy and their request for a balanced solution, and young members of the New Left, with their tendency toward unorganized forms of struggle and their intransigent anti-nuclear unilateralism. Furthermore, the anti-nuclear movement came out "strongly intertwined with parties and political debate" and characterized by the "projection" of the left-wing parties' juvenile organizations on it.[27]

Different, but United? The November 1981 Florence Convention

Italian sociologist Giovanni Lodi defined the movement's features as "united and different". According to him, the fact that the movement had a shared platform and a manifold structure was an element of extraordinary strength[28]. While there is no doubt about the movement's multiplicity, uncertainty remains about its cohesion.

The leftist Catholic journal *Testimonianze* launched the idea of a convention in Florence, scheduled on November 14-15, 1981, only a few days after the large Rome demonstration. The number and the quality of participation (more than 2,000 crowded the Auditorum of the Palazzo dei Congressi)[29] transformed the meeting into a sort of national conference of Italian pacifism. The main mass force supporting the movement remained the Communists who, however, remained internally divided. The party leadership asked for a "reversal from the Comiso decision",[30] it advanced a proposal for a

25 Tosatti, "Roma, imponente sfilata".

26 Alessandro Pizzorno, "Political Exchange and Collective Identity in Industrial Conflict", in *The Resurgence of Class Conflict in Western Europe since 1968*, ed. Colin Crouch and Alessando Pizzorno, vol. 2, *Comparative Analyses* (London: Palgrave Macmillan, 1978), 277-98.

27 Baccelli and Della Croce, "Il risveglio", 113.

28 Lodi, *Uniti e diversi*.

29 *Se vuoi la pace, prepara la pace. Atti del Convegno Nazionale di "Testimonianze"*, *Testimonianze* 25, no. 1-3 (January-March 1982), 7.

30 *Se vuoi la pace*, 55.

balanced disarmament, and held a traditional collateral vision of the peace movement as a "supporter". At the convention, Lucio Lombardo Radice commented about the movement that, "*It is not true it is spontaneous*. I am against this definition; it is, however, an *autonomous* movement, and it has to remain as such. It must have its individuality, its features, its autonomy, as trade unions, the women's movement, and other movements have".[31] The Federazione Giovani Comunisti Italiani (FGCI) had a very different position, and seemed willing to openly discuss the issues anti-militarist and nonviolent activists were proposing, such as unilateral disarmament, the exit from the North Atlantic Treaty Organization (NATO), conscientious objection,[32] even though young Communists shared with party leaders the need to pursue a "political synthesis and solution".[33]

The PR represented the real alternative political reference point. Radicals were intransigently anti-Communist: they probably considered the Soviet Union to be more dangerous than the United States,[34] they supported forms of civil disobedience, and reproached Communists for proposing what Marco Boato has called old "international mobilization models" coming from the "Vietnam age", which they deemed no longer acceptable given that now "international reality" was "different".[35] More than on the issue of missiles, Radicals focused on military budgets and preferred demonstrative actions (like Marco Pannella's hunger strike against "the Holocaust and extermination of 30 million people dying from hunger in Third and Fourth World countries")[36] to mass gatherings. A minority but ideologically aggressive (with the exception of the evangelical Movimento internazionale per la Riconciliazione, MIR, linked to the International Fellowship of Reconciliation, IFOR)[37] galaxy of small movements was connected to the Radicals: the Movimento Nonviolento polemicized with the Catholic and Communist underestimation of nonviolence, it supported conscientious objection and asked for "popular nonviolent defense";[38] the Lega per il disarmo unilaterale, which was close to the Radicals and was promoted by writer Carlo Cassola, promoted antimilitarism,[39] a struggle for unilateral disarmament[40] and a rejection of both NATO and the clauses of the Italian Constitution that made the country "an armed nation".[41] This coalition cri-

31 *Se vuoi la pace*, 53.
32 *Se vuoi la pace*, 202.
33 *Se vuoi la pace*, 211-12.
34 See Francesco Rutelli's opinion quoted in *Se vuoi la pace*, 156.
35 *Se vuoi la pace*, 142.
36 *Se vuoi la pace*, 143.
37 *Se vuoi la pace*, 184.
38 *Se vuoi la pace*, 119, 166.
39 *Se vuoi la pace*, 137.
40 *Se vuoi la pace*, 138.
41 *Se vuoi la pace*, 160.

tiqued Communists and Catholics for not opposing in a clear-cut way the two blocs, as Angelo Gaccione of the Lega per il disarmo unilaterale stated in Florence;[42] for looking for "possible and concrete solutions" to the nuclear threat when non-violent solutions and total disarmament had already proved to be more effective, as physicist Antonino Drago argued;[43] for keeping silent over the "disgrace" of Italian weapon factories, as Gaccione pointed out; and for not supporting the rights of imprisoned antimilitarists and conscientious objectors.[44] This varied front shared an anti-institutional approach: according to the Evangelical Baptist pastor Davide Melodia, secretary of the Movimento Nonviolento, "the true peace culture of the future" could not establish itself "through institutions and power, but rather against institutions, against power".[45] Indeed, all these groups declared they were against "party mediation"[46]. The Movimento Nonviolento, MIR and the Lega per il disarmo unilaterale agreed on two objectives, namely the "objection to renewed military service" and the "tax objection" (refusing to pay taxes intended "for military expenses", and devolving the sum to instruments of peace), which they linked to "civil disobedience and no-collaboration campaigns", not with nuclear issues.[47] When their protest concerned nuclear issues, they refused to focus exclusively on military aspects: one of their proposals was the promotion of "a League of Municipalities that would refuse missile installations and the installation of any nuclear structure", explaining that this was a "'no' to both civilian and military nuclear power, not only to Euromissiles".[48]

A third component of the movement was made of New Left groups and parties, such as DP and Lotta continua, which stood halfway between Communists and antimilitarists. Whereas their Marxist culture drew them closer to the former but distanced them from the pacifist and nonviolent movements, their antagonistic culture drew them closer to the latter. As Rossana Rossanda told the Florence audience, the New Left groups were "*against bipolarisms*, not only in the sense that we are against the one and the other, but that we want their disaggregation".[49] These groups also contested the main Socialist and Communist trade union, the Confederazione Generale Italiana del Lavoro (CGIL), for not devoting enough attention to the issue of weapons production.[50]

The promoters of the Convention, who were members of the Catholic Left, also stood halfway between Communists and antimilitarists. Along with the Communists,

42 *Se vuoi la pace*, 137-38.
43 *Se vuoi la pace*, 163-64.
44 *Se vuoi la pace*, 138.
45 *Se vuoi la pace*, 119.
46 *Se vuoi la pace*, 205.
47 *Se vuoi la pace*, 206.
48 *Se vuoi la pace*, 120.
49 *Se vuoi la pace*, 96.
50 *Se vuoi la pace*, 138, 73.

progressive Catholics did not approve of absolute pacifism, as, in the name of the Pax Christi group, theologian Enrico Chiavacci declared in Florence,[51] nor, as Raniero La Valle stated, did they share the Radicals' perspective of considering the struggle against the Soviet world as one of the features of the battle for peace.[52] However, as nonviolent groups and radicals, they seemed ready to use individual rather than political actions, highlighting the difference between conventional war and the use of nuclear weapons. They were convinced that the principle of legitimate defense was not valid in the case of the atomic bomb. They invited young conscripted soldiers, "in case of alarms and wars", to object "at least to the use of every nuclear weapon or to be trained in them"; they asked nuclear scientists to object; they promoted a campaign for the control, limitation and possible abolition of weapons production;[53] and they campaigned on issues relating to underdevelopment and hunger.[54]

It is undeniable that the Italian movement was characterized by a profound heterogeneity of perspectives. At the time, the Radical Marco Boato emphasized this point, which he considered as a positive aspect of a new "way of being together":

> One is pacifist to the limit, the other not. One thinks the whole of Europe must be denuclearized, the other is for unilateral disarmament etc. The fact is not that we are eclectic or aseptic in our judgements, because everyone among us is firmly convinced that some objectives are more valid than others, but nobody thinks any more, as others believed in the past, that this could be a discriminating factor inside the movement; while this is a discriminating factor, if anything, toward those who do not want anything of this and prefer to continue in the logic of terror, war and death.[55]

The opinion of the CIA experts was less optimistic and more realistic: according to them, "the preeminent role of the PCI in peace activity" had not "precluded differences within the movement over everything from ideology to tactics". "A broad community of purpose sometimes" had united "the diverse groups in demonstrations", but "major differences of attitude" clearly remained "never far from the surface", and caused "scuffles between rival groups on occasion".[56] In fact, internal contrasts were one of the main weaknesses of the Italian anti-nuclear movement.

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51 *Se vuoi la pace*, 58.

52 *Se vuoi la pace*, 157.

53 These were the Pax Christi's proposals: see *Se vuoi la pace*, 62-64.

54 *Se vuoi la pace*, 61.

55 *Se vuoi la pace*, 141.

56 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, NARA, FOIA, Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489.

To Win at Comiso (1982-1984)

Both Communists and Radicals transferred their target to Comiso. The slogan of the first large demonstration (10,000 participants)[57] held there on April 4, 1982 was: "To Win at Comiso".[58] Their objectives, however, remained divergent: on the one hand, Communists proposed a collection of signatures addressed to the government, asking for a "suspension of the works in the Comiso base"; on the other hand, Radicals wanted to create a large front of protesters in Comiso, to mobilize – as a Radical activist said in Florence –, "every … 'different' person": "heretics, Quakers, conscientious objectors with their refused request, and hence fugitive rebels, prostitutes, transsexuals, or drug addicts …, the homeless and the evicted, occasional and unemployed workers, oppressed and repressed persons, unmarried and aborted mothers, Iranian students oppressed by Khomeini".[59]

During the entire year 1982, a harsh dispute divided the Peace Committees. When, during Reagan's official visit to Italy, the PCI promoted a national demonstration in Rome to be held on June 5, the PR accused the promoters of "poor commitment against the military budget". At the international Comiso camp, which started in the summer, the antimilitarist and "unilateralist" wing created a separate organization, the Campo Internazionale per la Pace (CIP), which led to the first disturbances with the police.[60] At the Rome November 14 Peace Committees' national coordination meeting, a violent clash split the movement's different components.[61] Whereas the PCI supported the organization of a peace march from Milan to Comiso and the holding of a referendum against the installation of the missiles,[62] the Movimento Nonviolento, the Radicals, DP, the Lega per il disarmo unilaterale, along with representatives of the Federazione Giovanile Evangelica, argued that a Christmas antimilitarist march should be promoted, with the goal of establishing a "symbolic" blockade of military bases (as was done for the Sigonella NATO base).[63] A new meeting of the Peace Committees in Rome, held on January 23, 1983, succeeded in launching a common course of action,[64] but once again mobilization did not take off and new divisions arose. On August 8, at the new,

57 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, NARA, FOIA, Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489.

58 Baccelli and Della Croce, "Il risveglio", 114.

59 *Se vuoi la pace*, 197.

60 *Memoria Comiso. La Sicilia contro la guerra*, http://memoriacomiso.terrelibere.org/mostra_notizia.php?num=3&tab=info_cronologia, last accessed November 1, 2012.

61 *Memoria Comiso*.

62 "Appello per una marcia di pace da Milano a Comiso", *l'Unità*, November 7, 1982, 2.

63 *Memoria Comiso*.

64 Maria Giovanna Maglie, "Da Comiso a Ginevra la scommessa '83", *l'Unità*, January 26, 1983, 7.

unanimous, second International Meeting Against Cruise (IMAC),[65] held in Comiso, police charges left many people injured and arrested, and provoked a harsh confrontation between Communists and the government, which accused them of "grassroots adventurism".[66] On October 22, the biggest Italian demonstration against the missiles (which coincided with European forms of mobilization) was organized in Rome: it represented a great success, with around 500,000/one million people marching.[67] Once again, however, Radicals contested the one-sidedness of the Communist participation and organized their own separate demonstration, not surprisingly in Prague.[68] When, after the installation (without disturbances) of the first missiles, the PCI decided to ask the government for a public vote,[69] Radicals fiercely attacked the initiative, which ultimately failed. Radical leader Pannella stated – and was violently contested by the Communitsts – that the proposal to hold a referendum against the missiles in Comiso was offensive, because it neglected "the existence of other thousand and more nuclear pages in Italian history". He declared his hostility to every form of "unilateral pacifism", as well as to every "neutralist and pseudo-pacifist" form of opposition.[70]

An Appraisal

Both the CIA and Italian observers argued that, compared to other movements in INF basing countries, "peace activism in Italy" was "concentrated more on the far left".[71] Indeed, the movement had a common political basis, a sort of koiné, which was not rooted in the position of the Communists, or in the position of their nonviolent opponents, but rather in the culture of the New Left. The anti-missiles movement shared a series of features with other European movements, but in Italy they acquired a strong anti-system, anti-Western, and anti-liberal character. Starting from a disarmed form

65 Sergio Criscuoli, "Comiso, più di 1000 giovani si sdraiano davanti alla base", *l'Unità*, August 7, 1983, 1, 16.

66 "Provocazioni e scontri a Comiso", *Avanti!*, August 9, 1983, 1, 3; and Sergio Criscuoli, "Segnale politico allarmante", *l'Unità*, agosto 9, 1983, 1, 16.

67 Carlo Ruzza, "Institutional Actors and the Italian Peace Movement: Specializing and Branching out", *Theory and Society* 26, no. 1 (1997): 87-127, see 92.

68 "Pacifismo a senso unico: ancora no degli intellettuali", *Avanti!*, October 9, 1983, 1, 3; and "Una grande spinta organizzativa per la marcia pacifista a Roma. Sforzo organizzativo per la marcia di Roma", *Avanti!*, October 22, 1983, 1, 3.

69 "Il comunicato della segreteria", *l'Unità*, March 27, 1984, 1.

70 "L'Italia persegue la via della trattativa" and "Scontro tra due opposti pacifismi", *Avanti!*, April 4, 1984, respectively 1, 16 and 1, 3.

71 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, NARA, FOIA, Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489; and *Se vuoi la pace*, 114.

of neutralism, they proposed, against multilateral forms of disarmament, to exit from NATO (as a facilitator of a similar dissolution of the Warsaw Pact), to abolish military conscription, and adoption Gandhian strategies of passive resistance.[72] Notwithstanding the Radicals' campaigns, the majority of the movement was convinced that the threat to peace came more from American and European anti-Communism than from Soviet political and military power.[73] It did not only reject US foreign policy but also the American (and Western) model as such. In a poem written for the peace movement, "Salmodia per la pace", father Davide Turoldo wrote: "And the worst of all evils is that everything, everything becomes Western"; and, "the deadly disease is the West". Revolutionary armed movements in the Third World were treated with remarkable indulgence,[74] environmentalism was interpreted in a radical and anti-industrialist way,[75] and feminism in an antagonist and catastrophist key. In February 1980, a group of feminists in Naples wrote, "in a society based on commodities and trade, we can no longer produce 'commodities of life' for deadly purposes, commodities of life that disdain life. We cannot produce life following an ideology of love, and allocate it to the system's lacerations we experience today". "Let us suspend motherhood", they proclaimed, "until society is totally transformed".[76] Pessimism and existential anguish prevailed, and writer Carlo Cassola was convinced there was only a 15 per cent chance that mankind would survive after the year 2000.[77] In spite of scientists' and physicians' commitment,[78] nuclear weapons were not considered as a problem per se, but as the symptom of a meaningless social development.[79] The movement opposed traditional politics, and the 1983 rift was between those, such as the left-wing parties, who demanded more political organization and those, such as environmentalists, feminists, and nonviolent activists, who criticized the movement for promoting homogeneity and hierarchies.

72 Carlo Cassola, *Contro le armi* (Marmirolo, RE: Ciminiera, 1980); Cassola, *La società militarista* (Firenze: Rotoffset, 1982); Cassola *La rivoluzione disarmista* (Milano: Rizzoli, 1983); Cassola, *Disarmo o barbarie*, ed. Bruno Zanotti, afterword by Cesare Medail (Trento: New Magazine, 1984). But see also Adriana Chemello, "Le donne di fronte alla nonviolenza," in *Per un futuro non violento. Lotte delle donne, non violenza, pacifismo*, ed. Chemello (Torino: Cooperativa Satyagraha, 1984), 27-30; Chemello, "Spezziamo il fucile. Una campagna per l'obiezione di coscienza femminile", in *Per un futuro*, ed. Chemello, 85-88.

73 *Se vuoi la pace*, 27, 155.

74 *Se vuoi la pace*, 117.

75 *Se vuoi la pace*, 97, 169.

76 Qt. in Chemello, *Per un futuro nonviolento*, 76.

77 Qt. in Pàstena, *Breve storia*, 153.

78 See Adriano Buzzati-Traverso, *Morte nucleare in Italia* (Roma-Bari: Laterza, 1982), and Antonino Drago and Giovanni Salio, eds., *Scienza e guerra. I fisici contro la guerra nucleare* (Torino: Edizioni Gruppo Abele, 1983).

79 *Se vuoi la pace*, 26.

Given these features, what kind of conclusion can we draw about the movement's relevance? Many data seem contradictory: a survey carried out in summer 1983 demonstrated that 59,9 per cent of Italians was against the installation of missiles.[80] However, the movement did not succeed in imposing the atomic issue on public opinion. As Fabrizio Battistelli (a participating observer) wrote, the bomb still remained "the great Absent" from the analysis.[81] There is some evidence that the government expressed concern about the size of the peace movement, but we also have evidence that the movement did not represent a serious political threat. At the May 1983 Williamsburg Summit, participants debated fiercely about peace movements. As Italian Prime Minister Amintore Fanfani recounted in his diaries, together with the West German and Canadian Prime Ministers Helmut Kohl and Justin Trudeau, he insisted on the "NATO difficulty in negotiating both with the Soviet Union and its public opinion" and on the need to "clarify that we want peace, and then explain why, in order to have it, we have to deploy the missiles", and pushed Margaret Thatcher to react and accuse them of "servility to Moscow".[82] At the same time, CIA experts pointed out that the Italian peace movement "so far" had "focused mostly on organizing protest demonstrations and rallies and circulating petitions". Only "some groups" had advocated "more vigorous tactics to impede GLCM [ground-launched cruise missile] base construction at Comiso, Sicily, and a few demonstrators" had "tried to obstruct construction vehicles". According to the CIA, the movement was still under the influence of the Communists. "In principle", it consisted of "more than 500 local, regional and national committees and associations representing both secular and religious organizations across the political spectrum, with the exception of the extreme right". In fact, "most of the non-Communist groups" had "a small membership, and no strong national organization devoted exclusively to 'peace'" had "arisen". The "small Radical Party" was "militant and active", but "its influence" was "weak". Thus the movement had "suffered from a leadership vacuum": "no major political figure" had "made a full commitment to the peace movement", and "the movement itself" had "not produced a charismatic figure capable of transforming it into an independent force" that could "exert significant pressure on the Italian Government". The CIA's conclusion was that the movement against Euromissiles posed "no threat to the stability of the government or to the successful installation of GLCMs in Sicily".[83]

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80 Giorgio Gatta, "Missili a Comiso? Piacciono a pochi", *Panorama Mese*, July 13, 1983, 54-55, see 54.

81 Fabrizio Battistelli, "L'Accademia degli Ammutoliti. Gli intellettuali italiani e la Bomba", in *Educazione e cultura della pace*, ed. Paolo Serreri (Roma: Editori Riuniti, 1988), 72.

82 Archivio storico del Senato della Repubblica, Roma, Italia, Fondo Amintore Fanfani, Diario, 1983, May 28 and 29, 1983.

83 *Peace Groups and Leaders in INF Basing Countries*, November 1, 1982, NARA, FOIA, Directorate of Intelligence, Central Intelligence Agency, DDRS, 1990, doc. n. 2489.

Any evaluation depends on the way in which one looks at movements: whether one considers their immediate impact on political decisions, or their long-term influence on political cultures and mentalities. In the first case, it is obvious that the Italian anti-nuclear movement suffered a clear political. In the second case, already at the time many observers argued that a deep transformation in politics had occurred. The Communist Ennio Polito wrote of "new forms of individual and mass participation, which often rejected traditional parties' hegemony".[84] The Radical Marco Boato spoke of "the crisis of politics" and of the "party system", and pointed out that the anti-nuclear movement was the expression "of a different politicization", because it had brought a deep transformation of what it meant to "being left-wing".[85] The Catholic Paolo Giuntella argued that "ecologists, "greens", radicals, pacifists" had "lifestyles, sensibilities, leanings in daily life much different from the lifestyles, daily life, ethicality, ideas about family and education" prevalent in the Left.[86] Indeed, some members of the antinuclear movement, even though initially weak, left a long-lasting legacy, namely a strong critique of ideologies and parties; the pursuit of direct action and civil disobedience; a new grassroots form of politics; a political culture based on individuality and critical of Communists' and Catholics' emphasis on the community; a split between Catholics and the DC and between the youth and the PCI. Therefore, anyone wanting to investigate the reasons behind the crisis and the end Italy's "Republic of Parties"[87] has to take into account the story of the early 1980s anti-nuclear movement, which probably represents one of the deep roots of that crisis.

84 Ennio Polito, "C'è anche una nuova idea di Europa nel movimento per la pace", *l'Unità*, October 27, 1981, 1, 18.

85 *Se vuoi la pace*, 141.

86 Paolo Giuntella, "Essere di sinistra", *Appunti di cultura e politica* 7-8 (July-August 1982): 15.

87 Pietro Scoppola, *La repubblica dei partiti. Profilo storico della democrazia in Italia (1945-1990)* (Bologna: il Mulino, 1991).

Angelo Baracca, Saverio Craparo, Roberto Livi, Stefano Ruffo

The Role of Physics Students at the University of Florence in the Early Italian Anti-nuclear Movements (1975-1987)

No reconstruction of the history of civilian nuclear programs can be considered complete without a contextual attention to the attitude and role of public opinion: even less so in the case of Italy, where nuclear programs were buried by popular will with two referendums, in 1987 and then in 2011. This is a thorny problem, which must be addressed using different approaches than the ones offered by the history of technology, or of industry, which can be based on objective or official documents, reports, data, technical correspondence, and contracts. Changes in public opinion must instead be reconstructed drawing on personal recollection or interviews, newspaper articles, opinion surveys or polls, which can rarely be officially or objectively verified. It is not a coincidence that oral history has in recent decades become a respected academic discipline in fields in which official documents are lacking. Every approach has its own criteria of rigor, which cannot be considered better or worse, since it deals with different, although complementary problems, but can be difficult to compare. It is generally not easy to crosscheck the results of these two kinds of approaches. In particular, it seems difficult to ascertain to what extent opinions or new points of view spread in society and influence public opinion, at different levels, even as far as political positions are concerned. This is probably a sociological rather than a historical problem. For instance, how could one objectively "measure" how, and to what extent, the outcome of the 1987 referendum was the result of an increasingly anti-nuclear public opinion, or was instead influenced by the Chernobyl disaster? We argue that the evolution of public opinion, coupled with the increasing problems posed by unrealistic nuclear programs, had a deep influence on political positions and on the fate of the Italian nuclear plan. Otherwise, how could one explain why the minority anti-nuclear positions in the Partito Comunista Italiano (PCI) almost prevailed a decade later at the XVII Congress, on the eve of the Chernobyl disaster? (See below).

This chapter presents our personal recollections of the period, which was marked by a strong interest in the issue of nuclear power in Italy. We offer the viewpoint of a group of students, almost all from the Faculty of Physics of the University of Florence, and highlight their active public engagement in rising popular movements, and their favorable disputes with the scientific community and even with nuclear technicians.

A General Consideration

It is important to open our analysis with a premise. In the first half of the 1970s, when this story begins, most of us were students (and not all of us were students of physics). Angelo Baracca was the only graduate and professor of physics among us, although he had never attended a course specifically devoted to nuclear physics. Before the end of the 1970s, he was already politicized and was involved in various political movements concerned with environmental and health issues, but he had never dealt with problems of nuclear power.

Indeed, during a course of studies in physics, one learns only some basic notions about the physical properties of the atomic nucleus and radioactivity, at best concepts of nuclear fission and fusion, in relation to their civilian and military applications. Not even academic specialists in basic nuclear research have specific notions or skills in nuclear energy technology, as we have constantly and directly verified in the past decades. A nuclear physicist has a deeper knowledge of nuclear structures and properties, but the competence of general scientists to assess the real need, advantages or reliability of nuclear power is, in general, not much higher than that of learned and well-informed people.

How could it happen that a group of students (not even all of them physicists), working alone (there was no internet!), succeeded in a relatively short period of time in acquiring basic, but specific, physical and technical knowledge about nuclear technology? At a level that allowed them to keep up with professional researchers in nuclear physics, and even with civilian nuclear technicians! As for Professor Baracca, the aforementioned group of students introduced him to these issues, and only later did he become actively engaged in the field of nuclear technology.

All these considerations and our experience lead us to a conclusion. We are perfectly aware that the majority of people might not share our ideas. However, contrary to the prevailing arguments in the technical, scientific and economic milieus, we are deeply convinced that our position is valid. In our opinion and experience, nuclear technology is far from being an *advanced*, if not *the most* advanced, technology, as it is usually considered. It is instead an *extremely complicated* (not only a *complex*) and *rigid* technology, with sprawling ramifications, which are very dangerous and difficult to keep under control. These features are the opposite of an “advanced” technology, which must instead be flexible, adaptable, controllable, relatively simple, and in some sense reversible. Such a complicated technology induces specialists in the field to become super-specialized, and loose sight of the general picture and the complicated interweaving among the social, environmental, health and economic aspects of nuclear technology. In public debates, we have often found it relatively simple and effective to confront specialized nuclear technicians and to respond to specific technical arguments, by simply "widening" the point of view, and insisting on other intertwined aspects.

Some examples can clarify this point. Our group of students did not limit itself to nuclear power (which, at the time, was glorified by left-wing parties and unions, as well as by technicians, as a symbol of "Progress", branding every criticism as regressive, a "return to the candle"), but assumed a pioneering role and broadened its analysis to include "alternative" energy sources (as they were called then), about which nuclear scientists and technicians were widely insensitive and unprepared. Moreover, in that period of rampant nuclear power, there were not many concerns or programs for the management of nuclear waste and exhausted fuel. Civilian nuclear technicians hardly had any real knowledge about the military applications of nuclear power, or about proliferation risks and nuclear disarmament issues. The possibility of nuclear accidents and the dangers of radioactivity were strongly downplayed, as the accidents of the 1970s and 1980s dramatically demonstrated. One should add that specialized technicians were usually arrogant, they considered themselves repositories of the truth, from which common people were excluded, and assumed their arguments could not be challenged.

It is possible that this scientific mentality and approach were more accentuated in Italy, but it does not seem that the clash with the scientific community was so different in other countries.

In general, in that period an open contradiction took shape between the scientific community and the ideology of science as an intrinsic source of progress emerged from World War II, and against a growing popular common sense.

Prior Events and General Background

The 1970s represented an extremely complex decade, from a social and political point of view. The echoes of the radical student protests and of the May 1968 events in France were far from being dampened, while the "Hot Autumn" of 1969 opened a season of strong conflicts, which saw new forms of alliance and collaboration between the student movement and the working class. In particular, the establishment of new forms of direct democracy and representation, the Consigli di Fabbrica e di Zona, which were often inter-branch organisms that reinforced the unity of the movement.

The relatively small Faculty of Physics of the University of Florence (locally isolated, far from the city center and the remaining parts of the University, on Galileo's "Arcetri hill") had no political tradition, and in the first years of the student movement it was exceptionally quiet. Baracca took up position as lecturer (professor on an annual contract) on November 1, 1968. Around 1970-1971, students who matriculated revitalized and strongly politicized (in close collaboration with Professor Baracca) the embryo of a political committee of physics students, the Comitato Politico di Fisica (CPF), which had already been established but had had a difficult life. In a couple of years, the CPF took root among the students, and along with the Student Assembly it advanced important requests to the faculty. Furthermore, it forged bridges with the outside world, particularly with the working class, with the explicit consciousness that science had to undergo deep changes in order to answer the needs of the exploited class. One of the most important forms of cooperation with the working class, related to our topic, was the one established with the Commissione Organici e Investimenti del Consiglio di Fabbrica of the Nuovo Pignone, Florence's biggest and most technically advanced factory, which worked internationally to build turbines, and develop energy and oil technology. The need for, and the new opportunities offered by, renewable energies were among the main topics of discussion between the Commissione and the students of the CPF, and were introduced in open assembly debates of both factory workers and physics students.

One must remember that the unexpected 1973 oil crisis challenged all world forecasts on energy resources, production, and consumption. In Italy, at the beginning of 1974 the "oil crisis" had several grotesque implications, worth remembering in order to better understand subsequent developments. During the Yom Kippur War, several magistrates investigating the oil embargo found a few explosive documents belonging to oil managers, which compromised all Italian political parties (with the exception of the PCI), managers of the Ente Nazionale per l'Energia Elettrica (ENEL), and ministers, who were accused of carrying out illegal procedures and providing subsidies to the oil industry. As often happens in Italy, these allegations for corruption – involving billions of Italian lire – had no legal consequences on political representatives' and company managers' careers.

One of the results of the scandal was to allow the people who had put a stop to the Italian nuclear program (after the so-called "Ippolito scandal" in 1963) to re-emerge. In December 1973, ENEL, after being assured by the government that a new legislation would be introduced, decided to buy not one but two nuclear power plants, and in the summer of 1974 it increased its orders to four. In August 1975, the government passed a law regulating localization procedures, which drew on the recently published American "Reactor Safety Study" (known as the "Rasmussen Report"), establishing a 16-km-radius safety zone around nuclear plants (then confirmed in 1978 by the Nuclear

Regulatory Commission).[1] Following this law, ENEL advanced the idea that the four plants should be placed in Central Italy, two in the Lazio region (as we will show, one was built in Montalto di Castro) and two in the Molise region.

In December 1975, after oil prices suffered a further increase, the Comitato Nazionale per l'Energia Nucleare (CNEN) submitted a Piano Energetico Nazionale (PEN), which was approved by the Comitato Interministeriale per la Programmazione Economica (CIPE). The Plan forecast different (and highly inflated, as became clear later) scenarios for Italy's energy demand, and planned the installation of a total of 13,000-19,000 MW in nuclear power (up to twenty power stations) for the period 1983-1985, and the building of even more nuclear plants in order to achieve a total between 46,100 and 62,100 MW by 1990. Going back to our initial premise about the nature of nuclear technology, and the attitude of the Italian scientific community, it seems hard to believe that no Italian scientist ever wondered how fifty-seventy nuclear power plants could fit, and respect all the necessary safety rules, on the densely populated and often inhospitable Italian territory!

The Autonomous Research of the Students Leading to *I Nucleodollari*, 1975-1977

In the late spring of 1975, students of the CPF were involved almost by chance in discussions about the PEN, when they participated – talking a critical standpoint – to a public debate organized by ENEL in Florence, in which several professors of physics also took part (as they were considered "experts", although they had little experience about energy issues). Students were strongly criticized (with paternalistic and sarcastic tones) for their improvisation and lack of preparation.

Burned by this experience, they succeeded in obtaining a copy of the PEN, and felt the need to study the whole problem more seriously and rigorously. As a result, in the fall of 1975 they established a students' working group, which was collateral but formally independent from the CPF. It was composed almost entirely of students of physics (with the exception of Lorenzo Vallerini, who studied architecture): Sergio Ciliberto, Saverio Craparo, Giovanni Del Fante, Roberto Livi, Marco Lugli, Marco Pettini, Antonio Politi, Andrea Raspini. Their average age was twenty-three. The group met weekly for more than a year,[2] it collected all the documents it could find, sharing the tasks but

1 It should be said that a large portion of the plants built in previous decades, following these regulations, are at present at much smaller, hence unsafe, distances from residential areas.

2 The meetings of the working group took place in the evenings, excluding the daily commuter students. On the other hand, the division of labor was a usual practice among the limited number of students of physics, and this always took place in complete harmony. According to the authors of this chapter, Stefano

discussing collectively all the problems and results. It also repeatedly consulted with outside experts, such as geologist Giorgio Marinelli from Pisa. It must be stressed that (of course) at the time there was no Internet, and that the technical documents concerning specific issues (such as nuclear technology) were rare and/or very specialized, and not easy to understand.[3] As we have already pointed out, the academic curriculum in physics provided only superficial notions about nuclear technology (just the notions of nuclear fission and fusion, or the role of nuclear fusion in stars), and (often until now, at least in Italy) no information about energy issues and renewable sources. As mentioned, the perspectives and opportunities offered by renewable energies had already been at the core (although still in general terms) of debates between workers technicians of Nuovo Pignone and students of physics.

After more than one year of studies, Saverio Craparo's proposal to write and publish a book was accepted – it appeared in the spring of 1977 with the title *I nucleodollari*.[4] The volume was one of the first comprehensive studies to be published, at least in Italy.[5] It was accessible to the general public, and offered a broad view, an economic as well as a political analysis, an evaluation of costs, and devoted a specific attention to alternative energies, and comparative evaluations. The title chosen for the book evoked the political dimension of prevailing energy choices. It drew attention to the fact that "hard" energies, whether fossil or nuclear fuels, were ultimately controlled by, and benefited, big business, exploiting and bypassing collective interests (as was clear in the case of Italy's

Ruffo, who was very active in the CPF but resided some twenty kilometres outside Florence, was penalized, although he later re-engaged very actively in the anti-nuclear movement, as we shall see.

3 The references explicitly cited in the book *I nucleodollari* include: David J. Rose, "Nuclear Electric Power", in *Energy: Use, Conservation and Supply*, ed. Philip Hauge Abelson (Washington: American Association for the Advancement of Science, 1974): 89; *La crisi energetica*, monographic issue, *Sapere* 769 (February 1974); *Libro bianco su Caorso*, ed. Confederazioni Sindacali: see G. B. Zorzoli, "La prospettiva nucleare europea: ne discutono operai, contadini, ricercatori. Libro Bianco su Caorso", *Sapere* 784 (July 1975): 52; Zorzoli, *Fisica Sperimentale dei Reattori Nucleari* (Milano: Feltrinelli, 1971): a technical treaty on neutron physics, no specific treatment of nuclear reactors; Zorzoli, *Il Dilemma Energetico* (Milano: Feltrinelli, 1975); Zorzoli, "Il fascino discreto dell'energia nucleare", *Sapere* 783 (June 1975): 57-65; Zorzoli, *Proposte per il Futuro* (Milano: Feltrinelli, 1976); Zorzoli, "Industria nucleare e politica energetica", in *Chi ha paura del sole? Problemi e limiti della scelta nucleare*, ed. Marco Martorelli (Milano: Mazzotta, 1976), 26-40; Giorgio Nebbia, "I conti sbagliati del programma nucleare", *Mondo Operaio* 10 (1976), 67-75.

4 Sergio Ciliberto, Saverio Craparo, Giovanni Del Fante, Roberto Livi, Marco Lugli, Marco Pettini, Antonio Politi, Andrea Raspini and Lorenzo Vallerini, *I Nucleodollari. Costi e rischi dell'energia nucleare in Italia. Le alternative possibili*, with a foreword by Angelo Baracca (Florence, CP Editrice: 1977).

5 Previous analyses had appeared, but they were mainly political polemics, e.g. Mario Silvestri, *Il costo della menzogna. Italia nucleare 1945-1968* (Turin: Einaudi, 1968).

ambitious nuclear project, which was sunk in the early 1960s with the "Ippolito affair", leading the country to be strongly dependent on fossil fuels).[6]

The structure of the book revolved around the following topics: the energy model in the West and in Italy; the uranium cycle and nuclear reactors; political and economic analyses of the nuclear choice; environmental problems of the nuclear choice; alternative energy sources (as they were called at that time); plutonium and breeder reactors. This last issue was relatively new for the Italian public, but at the center of much attention, given that ENEL was launching a demanding and costly program to participate in the French fast breeder reactor (FBR) project. The authors strongly criticized such an alternative as unrealistic and dangerous. Four explanatory boxes devoted to enriched the book: radioactivity, nuclear energy, nuclear reactors, and breeders.

An excerpt from the conclusion gives a sense of the radical but articulate approach of the book, and its effort to relate the energy system and energy choices to the specific social situation of the time:

> Therefore the trend to replace conventional with nuclear energy cannot simply be rationally approached, but must be entirely rejected.
> Although we have so far expressed a heavily negative opinion on the perspective of replacing (even gradually) oil with nuclear energy, one must not believe that this authorizes us to speak of nuclear energy as "bad" in itself. It is a false problem to search for intrinsically good sources; rather, we must analyze the deep (ever existing) connections between the proposed ways of utilization and the relations of production in society.[7]

The analysis of all the possible technical choices concluded significantly that, "*The problem is political*".

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6 In fact, the ploy was twofold, since the ousting of Felice Ippolito coincided with the elimination of Enrico Mattei, who tried to develop a national oil policy contrasting the interests of the so-called "Seven Sisters": this gave the green light to Italy's incresed dependence on fossil fuels, until the "nuclear party" tried to re-emerge around the mid-1970s with unrealistic projects. Among the plentiful literature available, we refer to the sharp analysis of Angelo Baracca, Giorgio Ferrari, Roberto Renzetti, "The 'go-stop-go' of Italian Civil Nuclear Programs, Beset by Lack of Strategic Planning, Exploitation for Personal Gain and Unscrupulous Political Conspiracies: 1946-1987", forthcoming (a preliminary version was published as Angelo Baracca, Giorgio Ferrari, Matteo Gerlini, Roberto Renzetti, "The 'Go-and-Stop' of the Italian Civil Nuclear Programs, among Improvisations, Ambitions, and Conspiracies" in *A Comparison of European Nuclear Energy Programs*, ed. Albert Presas i Puig, (Berlin: Max-Planck-Institut für Wissenshaftsgeschichte, Preprint 419, 2011), 51-70, https://www.mpiwg-berlin.mpg.de/en/resources/preprints, last accessed May 1, 2016.

7 Ciliberto et al., *I Nucleodollari*, 185.

Concrete Initiatives in the Growing Italian Anti-nuclear Movement

The book circulated widely among the growing anti-nuclear movements, a remarkable result considering that in that phase connections were still evolving, and there was no general national coordination, and, above all, that the main left-wing forces strongly supported nuclear energy. The student group was invited in numerous public meetings and debates, in which – as we mentioned – they had no problem confronting ENEL technicians or university specialists. In particular, they received invitations by the population of several towns the successive editions of PEN designated as potential nuclear sites. Unfortunately, no complete record is left of the public meetings held in Pisa, Varese, Casalmaggiore, Genova, and Cremona.

A crowded meeting we vividly remember was held in Florence. It was organized by professors and specialists from the Faculty of Nuclear Engineering of the University of Pisa, and saw a large participation of professors of Nuclear Physics from the Institute of Physics of the University of Florence (several of whom were members of the PCI). Their aim was clearly to use their academic authority to establish, "with no ifs and buts", the absolute validity, modernity, and safety of nuclear technology. However, at thes meeting these "specialists" met their match: they insistently asked critics or opponents of nuclear power to "bring objective data", but they could not reply to the arguments presented by some of the students on a less technical and more general ground, closer to common sense.

It seems relevant to highlight the spirit of this (and other) forms of political engagement. At that time, there was a complete "division of labor" and interchangeability among the members of the student group (even with Professor Baracca): it was not relevant *who* accomplished a specific task, but that *the tasks were accomplished*.

In the meantime, the debate on nuclear energy grew, along with the anti-nuclear movement, involving larger sector of society as well as members of the cultural and technical elites. One of the most important initiatives taken in the 1970s was the launching of a new series of the monthly magazine *Sapere* entrusted by the publisher Dedalo to the direction of Giulio Maccacaro – a physician who was deeply engaged ideologically – between 1974 and his premature death in 1977 (although the magazine continued to be published by the editorial group until 1982). Maccacaro surrounded himself with a group of involved and (not merely academically) qualified collaborators, which became an extraordinary breeding ground, and a political school, for left-wing scientists and workers' representatives who wanted to offer a critical analysis of science and society. Between 1978 and 1979, *Sapere* published five broad and in-depth special issues on nuclear energy, the energy problem and alternative energy.[8]

8 They were: *Il rischio nucleare. Leggiamo criticamente il Rapporto Rasmussen*, special issue, *Sapere* 809 (March 1978) (a premonitory, comprehensive critical analysis of the official underestimation of the risk

There were other initiatives as well: the journal *Quaderni del Comitato siciliano per il controllo delle scelte energetiche* was established in 1979, and had a national resonance. It was explicitly devoted to energy choices, and nuclear power received special attention. At that time, even local political and critical initiatives spread generally, and more directly that in the times of the Internet. Another important initiative was the magazine *Rosso Vivo*, created in 1979 by ecologist Dario Paccino (author in 1972 of *L'imbroglio ecologico*).[9]

Anti-nuclear movements drew on these critical analyses, and grew considerably. As the succession of events became increasingly feverish and excited, the nuclear problem emerged as one of the hottest issues debated in Italy.

1979, the Student Group Dissolves, and in Part Reassembles. The New Frontier of Nuclear Disarmament

In 1979, the authors of *I Nucleodollari* dissolved for "physiological" reasons, since most of them became absorbed in the preparation of their bachelor theses. They then became professionally engaged and in part dispersed in different towns. However, some of them met again several years later and engaged in similar activities, although no longer as students.

In the meantime Professor Baracca, who had previously been concerned with other issues (on which he worked with the same students of the CPF, two of which, Livi and Ruffo, prepared their theses with him), "inherited" the legacy of the student group and, as a professor, developed and expanded it further.

The March 28, 1979 Three Mile Island accident gave new impetus to the anti-nuclear movement. During the 1980s, public initiatives multiplied, especially in secondary schools, where ENEL was particularly interested in promoting nuclear energy. The initiatives always took the form of a debate between a "popular expert" and an ENEL technician or nuclear expert, but the latter invariably met with a strong opposition.

In the meantime, nuclear issues became more complicated, with the problem of Euromissiles being installed and the concrete risk of a nuclear confrontation between the Western and the Eastern blocs. The anti-nuclear movement assumed an antiwar character, fighting mostly for nuclear disarmament, although the opposition to nuclear power continued.

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of nuclear accidents); *Energia. Il nucleare: una scelta imposta*, special issue, *Sapere* 810 (April-May 1978) (an extensive monograph – 160 pages. Due to a series of "academic accidents", an essay by the authors of I *Nucleodollari* was excluded); *Energia. Le condizioni per l'alternativa*, special issue, *Sapere* 813 (September-October 1978) (94 pages); *Energia. Il dibattito nel movimento*, special issue, *Sapere* 815 (December 1978); *Il rischio nucleare. Lo scheletro nell'armadio*, special issue, *Sapere* 819 (June 1979).

9 Dario Paccino, *L'imbroglio ecologico. L'ideologia della natura* (Torino: Einaudi, 1972).

Baracca became strongly involved on both fronts. In 1981, he launched a document of Italian physicists against the deployment of new cruise missiles in Comiso, Sicily (although this action had its core at the University of Rome, and was promoted by Professor Edoardo Amaldi, who was the first authoritative signatory). In 1982, riding the wave of this document's success (which had almost 900 signatories), he was among the promoters of the Unione Scienziati per il Disarmo (USPID).

In 1981-1982 Ruffo, who graduated with Baracca, held a public debate on cruise missiles in Florence. In 1982, the Florence section of USPID was established, revolving around Baracca, Ruffo and Livi, with the latter as its secretary. USPID held numerous public activities, mainly aimed at high schools, and promoted and spread an official document on the effects of nuclear explosions.

Ruffo established a collaboration with the Forum per i Problemi della Pace e della Guerra, an organization that was independently founded in Florence in 1984, and had a more academic and less radical position than USPID, potentially juxtaposed to it. In particular, mention of both problems of "peace and war" sounded ambiguous, at least to many of the Florentine members of USPID, but a contrast between two pacifist organizations seemed absurd, especially in that delicate and dangerous phase. Ruffo's fruitful relationship with the Forum led to the publication of an article for the fourth issue of its *Quaderni*.[10] It focused on horizontal nuclear proliferation, in particular the increased risks of dual-use following the expansion of civilian nuclear programs, an issue that contributed to link movements against civilian nuclear programs to those in support of nuclear disarmament. Ruffo analyzed the nuclear fuel cycle and the risks of diversion in the manufacture of nuclear weapons, particularly in relation to fissionable plutonium in nuclear waste, and discussed the practicability of a nuclear-powered plan using reactor-grade material. He emphasized in particular the risks of horizontal proliferation.

Baracca's Involvement with Democrazia Proletaria in the Tuscan Regional Council, up to the Chernobyl Disaster

In 1985, the extreme left-wing party Democrazia Proletaria (DP) nominated Baracca head of the list for the regional elections of Tuscany, as a well-known representative of the anti-nuclear and antiwar movements. He was elected regional councilor. One of the central points of the electoral program was, along with numerous social and envi-

10 Stefano Ruffo, "La proliferazione orizzontale delle armi nucleari e l'utilizzo pacifico dell'energia nucleare", *Quaderni del Forum per i problemi della pace e della guerra* 4 (December 1987): 1.

ronmental issues, an opposition to the fast breeder reactor (FBR) program, which was supposed to lead to the building of a reactor on the Apennines between Tuscany and Emilia-Romagna, not far from Florence and Bologna, an unsuitable place for a nuclear reactor. The project aimed at establishing an experimental FBR, called Prova Elementi di Combustibile (PEC), which, after previous redirections, was formally designed to test the fuel elements for the French FBRs' spinneret. Italy would thus contribute to the FBR program while at the same time participating financially by obtaining a 33 per cent share.[11] In 1985, the reactor not only presented severe design shortcomings, but also suffered an enormous delay with respect to the overall program, to such an extent that it became irrelevant for the French program. As one document put it, "old errors added to the persistent incapability of realization and of relations with industry".[12]

At the beginning of 1986, DP's regional group organized an all-inclusive survey about the PEC. It was carefully prepared, and preceded by the organization of local public assemblies. A series of meetings with local administrations and the local health boards of the provinces of Prato, Pistoia, and Porretta Terme (where the center was located) revealed the existence of serious problems (although health boards were more aware of the issues connected to PEC):

– they had no data on the state of health of the population, nor were they in a condition to undertake a survey about it;
– they *had never even considered the problems connected to PEC*, in particular the need to monitor specific pathologies in the most exposed population groups, nor were they able to start the process rapidly (just a few weeks after the meeting, 13.5 tons of low activity uranium stealthily arrived at Brasimone and, according to official

11 The first Italian FBR program was proposed, very ambitiously, as early as 1962-1963. It was based on the uranium-thorium fuel cycle, and was called Rapido-Torio-Uranio-Sodio (RAPTUS). After the "Ippolito affair," CNEN's second five-year plan (1965-1968) included the PEC project, devoted to the development of a fuel element for an Italian FBR. Due to political pressures from the Christian Democratic congressman Angelo Salizzoni, from the Emilia-Romagna Region, and in contrast with the technical and safety requirements needed, PEC was to be built in the inadequate research area of Brasimone, where a "dome" previously built for the Progetto Reattore Organico (PRO) could be used, given that the PRO project was impracticable. The project was approved only in 1974, when ENEL decided to participate in the French FBR program, along with West Germany. Funding for the program rose from 100 to 196,5 billion lire (of which the PEC covered 29 per cent), and was not accompanied by an official political decision, presenting the Italian Parliament with a "fait accompli", along with an established practice. French technical experts pointed out that the PEC project had to be completely redone, reducing from three to one the planned proof channels (see below). It should be remembered that the project of the three channels had been entrusted to the American company APDA, at a cost of 500 billion lire, while the "path of the fuel" was assigned first to the English Electric society, then to the French, at a cost of 115 billion lire.

12 *Libro bianco sul reattore nucleare PEC del Brasimone*, ed. Gruppo Consiliare di Democrazia Proletaria (Florence: Consiglio Regionale Toscano, 1986), 36.

plans, in 1987 the first charge of plutonium could have arrived, nullifying the creation of a previous socio-medical database);
– they suffered a shortage of qualified staff.

No scheme existed for an emergency plan, and there was no study concerning the socio-economic effects a possible accident might have (which could divide the peninsula in two, given that the town of Brasimone was just a short distance from Italy's two most vital communication arteries connecting the North to the South, the freeway and the railway).

The core of the survey was an official inspection by the DP delegation of the Brasimone research center. The delegation consisted of Professor Baracca, the DP regional secretary, and the physicists Paolo Bartolomei (a member of DP Bologna and of the Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile, ENEA, Bologna) and Giorgio Cortellessa (from the Istituto Superiore di Sanità, Rome). After visiting the plant, the delegation held a lively four-hour meeting with ENEA's technical staff and the plant's development engineers. Every aspect was carefully discussed, and the delegation severely questioned the project's alleged design shortcomings or errors: in particular, the space for testing and operation, and consequently the plant's safety, which was inherited from the adaptation of the vessel built for a previous nuclear design, the Progetto Reattore Organico (PRO).

Some excerpts from the full transcript of that lively discussion are sufficiently eloquent:

> *DP* – "… this means that we have wiped away the breeding".
> *ENEA* – "For the next ten, twenty years yes".
> *DP* – "One has the impression that one is very cramped for space … three channels are reduced to one not so much because there has been a change of philosophy … because they did not fit, and even so a difficulty exists … There is not yet a final design, such as to ensure that everything of the reactor fits".
> *ENEA* – "… the structure that derived [from the adaptation on the previous container], with 16-meter long channels, in the presence of thermal gradients and of phenomena of deformation, also under radiation, which could occur, did not give sufficient guarantees. … Certainly what you say is true, it is extremely adventurous to try to fit three independent circuits in the limited spaces that exist inside the metal container. You know the topic of the metal container well; you know that it was here [from the previous project…]; it is clear that it is an expensive constraint both for the plant design arrangement and the blockage of the equipment, and the problems conserning the assembling of pipes, components and instrumentation. It is really a problem of accessibility to the components that we have found".
> *DP* – "Such a blockage is not dangerous?"
> *ENEA* – "It not an optimal situation, no doubt. From the point of view of maintenance, and more directly of safety, specific problems must be solved.

> … one can say that [the remark] in quotation marks is true. … in order to solve these problems it is necessary to carry out a more sophisticated design …”.[13]

These substantial statements by the project designers left the entire DP delegation astonished, although not surprised, since they seemed almost obvious.

The Libro bianco sul reattore nucleare PEC del Brasimone prepared by the DP regional group after the survey was carried out was distributed to the regional council and presented to the press. It was a very critical phase of the Italian nuclear program. Meetings with the regional council and other political groups were organized in order to discuss and share the results, and a specific debate took place in the regional assembly.

In the meantime, the wind was changing at a national level. During the XVII Congress of the PCI (traditionally strongly pronuclear), held on April 9-13, 1986, an anti-nuclear motion was presented and was supported by almost 50 per cent of the votes. Two weeks later, on April 26, 1986, the Chernobyl disaster took place. It left a deep impression on Italians and led to widespread concern for the so-called “Chernobyl cloud” and the levels of radioactivity in food, a situation that reivigorated public debates and polemics.

On a local level, the survey carried out by the DP regional group and its results contributed to change the position of the PCI in Tuscany. The debate in the regional assembly ended with a vote in favor of shutting down PEC.

13 *Libro bianco*, ed. Gruppo Consigliare, 43-47 (excerpts from the transcription of the tape recording of the discussion).

Part IV - The Role of Scientists and Scientific Research

Giovanni Paoloni

Nuclear Energy and Science Policy in Post-war Italy*

Pre-war Roots

The first Italian researcher to mention the possibility of producing energy by breaking atomic nuclei was Enrico Fermi:

> This relationship between mass and energy doubtlessly implies great numbers. As an example, if we could free up the energy contained in 1 gram of material, we would generate more energy than the amount produced by a 1000 HP motor working flat out for three years. It may be stated, quite reasonably, that at least in the near future it does not seem likely that we shall find a way to free up these vast quantities of energy. Indeed, this is something we should hope for, because the first thing that the explosion of such a vast quantity of energy would do is blow to smithereens the physicist who had the misfortune to discover the way of producing it.[1]

Fermi was appointed as professor of theoretical physics at the University of Rome in 1926. Backed by Orso Mario Corbino, who was at that time Director of the University's Physics Institute, in 1927 and 1928 he assembled a group of young and brilliant researchers.[2] These were mostly graduating students (Emilio Segrè, Edoardo Amaldi,

* The first part of this paper has benefited from some findings in the Marconi Archives, which occurred during a Byrne-Bussey Marconi Fellowship I was awarded in the Spring 2016 for research on the relationship of Marconi with Italy.

1 Enrico Fermi, "Nota", in August Kopff, *Fondamenti della relatività einsteiniana* (Milano: Hoepli, 1923). Translations are mine unless otherwise indicated.

2 On Enrico Fermi: Francesco Cordella, Alberto De Gregorio, and Fabio Sebastiani, *Enrico Fermi. Gli anni italiani* (Roma: Editori Riuniti, 2001); Giulio Maltese, *Enrico Fermi in America. Una biografia scientifica* (Bologna: Zanichelli, 2003); Maltese, *Il Papa e l'Inquisitore. Enrico Fermi, Ettore Majorana, via Panisperna* (Bologna: Zanichelli, 2010). On the history of the Physics Institute: Giovanni Battimelli and Maria Grazia Ianniello, *Fermi e dintorni. Due secoli di fisica a Roma (1748-1960)* (Milano: Mondadori, 2013); Giovanni Battimelli, *L'eredità di Fermi. Storia fotografica dal 1927 al 1959 dagli archivi di Edoardo*

Ettore Majorana, and, later on, Bruno Pontecorvo), with the exception of Franco Rasetti, who was Corbino's assistant, and would become professor of spectroscopy in 1930, and Oscar D'Agostino, postgraduate scholar in radiochemistry, who joined the group in 1934.

Corbino was aware of the state of relative backwardness suffered by physics in Italy. While maintaining experimental activity on a decent level, with peaks of recognized international prestige, Italian physicists were still lacking momentum in research on theoretical models related to the structure of matter, which in those years had led elsewhere to the birth of the new physics of relativity and quanta. Around the mid-1920s, Corbino's influential position as senator, and twice a cabinet member, enabled him to transform the Physics Institute in Rome into a center where the new physics would be properly cultivated and taught. The appointment of Fermi was a milestone on this path. Fermi and Corbino worked together to bring the Institute to the level of the best research centers of the time. The Rome Institute, hitherto a peripheral element in the landscape of European physics, became in a few years one of the centers carrying out groundbreaking research in the new field at an international level. It is not surprising, in this perspective, that Rome would host the first International Congress of Nuclear Physics, in September 1931.

In January 1934, Irène Curie and Frédéric Joliot-Curie announced the discovery of artificial radioactivity. Fermi immediately decided to try to produce new radioactive elements by using neutron sources, rather than the alpha particles utilized by French physicists. They were, however, very expensive, well beyond the means of a single Italian university institute, even a well-financed one, as the Rome Institute was by Italian standards. Once again, Corbino's foresight proved of invaluable help. In November 1920, soon after his appointment as senator, he had been part of a commission for the study of Italian mining resources and the unification of mining laws. In this capacity, he had taken an active interest in the search for a supply of natural radioactive substances, which were rare and expensive, and also valuable for research. He was aware of their potential medical use and of their intrinsic interest, as sources of radiation, for experiments in fundamental physics. He was determined not to let Italian physicists – first of all the Institute in Rome – be cut off from groundbreaking research due to the scarcity of such resources.

During his term as Minister for the Economy, Corbino established a special office for the supply of radioactive substances. The Radium Office (as it was then called) was located in the rooms of the Physics Institute of the University of Rome, and was directed

Amaldi (Roma: Editori Riuniti, 2003). On Corbino: Battimelli, *Orso Mario Corbino*, in *Enciclopedia Italiana*, VIII appendice, *Il contributo italiano alla storia del pensiero* (Roma: Istituto della Enciclopedia Italiana, 2013), 659-63.

by Corbino's former assistant Giulio Cesare Trabacchi. When Corbino resigned from the cabinet in 1924, the growing importance of radioactive substances for medical use motivated a transfer of the Radium Office from the Economy Ministry to the Interior Ministry, which was at that time in charge of Public Health. In 1925, the Office was renamed the Physical Laboratory of Public Health. Its director was still Trabacchi, and its location was still at the Physics Institute of the University of Rome. In fact, it was under Corbino's control from its inception to the mid-1930s, when it relocated to become part of the newly founded Public Health Institute,[3] and even then, it kept a privileged association with the work of the Physics Institute.

When in need of expensive equipment, beyond their ordinary means, the physicists in the Institute eagerly called for Trabacchi's help, whom they nicknamed the "Divine Providence". This is what they did in 1934. As soon as they had access to neutron sources, in the Spring of 1934, Fermi and his group started the systematic targeting of the elements in the periodic table, by ascending order of atomic number. D'Agostino worked on the chemical separation and identification of the resulting radionuclides, in itself an important part of the process. The results were soon published as a series of letters to *La Ricerca Scientifica*, the newly started journal of the Italian Consiglio Nazionale delle Ricerche (CNR). Abstracts were immediately circulated to pre-eminent international nuclear physicists, and their significance was widely recognized. The most important discovery, however, was the unexpected result of increased effectiveness of neutrons in producing artificial radioactivity, when slowed by hydrogenated substances. This came in October, and Corbino, who immediately realized its applicative potential in both the energy and medical fields, pressed the group to patent the process, and to extend internationally the patent, issued in October 1934.[4]

Corbino did not take part personally in this research. He did not have the time nor, at that point, the expertise needed to work actively in the new field. It is clear that, in terms of scientific results, all the credit for the prestige that came in those years to what became known as the "Via Panisperna Institute" goes to the exceptional qualities of Fermi and his group. However, a number of academic, financial, and organizational conditions had to be met, to let their creative potential unfold effectively. This is where

3 With the support of the Rockefeller Foundation, the Public Health Institute was created in 1934 and located in a new and well-equipped building. This was just outside the newly built "Città Universitaria", the university campus designed by Marcello Piacentini and inaugurated in 1935, where a new Physics Institute was also being built. Both the Physics Institute and the Physical Laboratory were relocated in 1937. In fact, even after the relocation they kept their de facto association and were at a few minutes walking distance.

4 Edoardo Amaldi, "Personal Notes on Neutron Work in Rome in the '30s and Post-War European Collaboration in High Energy Physics", in *History of Twentieth Century Physics*, ed. Charles Wiener (Cambridge, MA: Academic Press, 1977), 293-351; Amaldi, "From the Discovery of Neutron to the Discovery of Nuclear Fission", in *Physics Report* 111, no. 1-4 (1979): 1-332.

the influence of the ubiquitous Corbino proved decisive. His vision was not limited to the identification of Fermi as a trump card: he fully understood the importance and profound meaning of the new developments in physics. His speech of September 1929 on the tasks of new experimental physics, at the annual congress of the Italian Society for the Advancement of Science, gained wide resonance in the national community as a manifesto for research on the properties of the atomic nucleus, where the topic of nuclear energy also surfaced.

Coming from Corbino, one should not regard it as a casual remark. Early in his career, the passion for electricity and its uses, in energy and communications, had driven him toward industry-related leading circles. In 1910, he had entered the board of directors of the electricity company recently founded in Rome by the local council. By 1929, he was board member in prominent electricity and telephone companies (including major players like Edison and Società Meridionale di Elettricità, SME). In a few years, he would join the board of banks of national interest, and be the prominent technical consultant in the restructuring of electricity, telephone, and radio-broadcasting companies, in the aftermath of the 1929 crisis. Corbino effectively exploited his position as a state technocrat and a leading member of the industrial establishment to expand his academic project for the development of physics in Italy. Throughout his whole life, he supported a close relationship between fundamental research and industrial development. This vision was a substantial part of his legacy.

From Survival to "Reconstruction"

Research in nuclear physics underwent significant changes in the mid-1930s, with the introduction of the new early particle accelerators. To keep their lead, the group in Rome had to upgrade their experimental equipment. In 1936, Corbino and Fermi started drawing up plans to establish a facility equipped with a particle accelerator: once more, association with the Public Health Institute would prove instrumental, providing room and the money to build a Cockroft-Walton accelerator. However, Fermi wanted a cyclotron, the new type of particle accelerator that Ernest Lawrence was developing in Berkeley. Early in 1937, Corbino died of pneumonia. Antonino Lo Surdo, a prominent researcher in Geophysics, but not particularly close to Fermi, succeeded him as director of the Physics Institute. In July, a heart attack took away Guglielmo Marconi, who had also been, thanks to Corbino, an influential sponsor of the Rome Institute, soon renamed after him. Fermi was formally told that adequate funding would not be granted; in addition, since his wife Laura was Jewish, his family was directly affected by the anti-Semitic legislation passed by the Italian government in

1938. When he was awarded the Nobel Prize for Physics, later that year, Fermi knew he no longer had reasonable prospects for scientific work in Italy, and decided that his journey to Stockholm should be one-way.[5]

The Fermi group vanished: Majorana had mysteriously disappeared in 1938; Segrè and Pontecorvo, both Jews, emigrated, and so did Rasetti, weary of the Fascist regime; D'Agostino went back to chemical research. In 1939, after an unsuccessful attempt to emigrate to the United States, the task of keeping alive nuclear physics in Rome fell on Amaldi, together with Bruno Ferretti (in Rome since 1937); Giancarlo Wick joined in 1940. Under their lead, and in close connection with Gilberto Bernardini, who held a chair in Bologna but frequently came along, a new group of researchers assembled in Rome: Oreste Piccioni, Marcello Conversi, Bruno Nestore Cacciapuoti and Ettore Pancini; for shorter periods, Giuseppe Cocconi, Piero Caldirola and Antonino Borsellino were also in Rome. Their research was once more associated with the Physical Laboratory at the Public Health Institute, where the Cockroft-Walton accelerator was now in operation. There, new staff had joined Trabacchi: Daria Bocciarelli, and in 1940 Mario Ageno, later to succeed him as director, and to become one of the founding fathers of biophysical research in Italy.[6]

The group adapted to the existing context by gradually refocusing research activities from the study of uranium fission (totally discontinued in mid-1941) to the study of neutron-proton and neutron-deuteron collisions, and of cosmic rays. On the one hand, they lacked the resources to do groundbreaking work on fission; on the other, they did not want to be involved in the development of nuclear weapons, should any such plan arise on the German side of the war. Moreover, there was a favorable tradition in Rome – also rooted in Corbino's legacy – in electronics, at that time named "electro-acoustics",

5 Edoardo Amaldi, *Da via Panisperna all'America. I fisici italiani e la seconda guerra mondiale*, ed. Giovanni Battimelli and Michelangelo De Maria (Roma: Editori Riuniti, 1997), 63; Giovanni Battimelli and Ivana Gambaro, "Un laboratorio per le alte energie alla vigilia della seconda guerra mondiale", in *Atti del XIV e XV Congresso Nazionale di Storia della Fisica (Udine 1993 - Lecce 1994)*, ed. Arcangelo Rossi (Lecce: Conte, 1995), 475-87; Battimelli and Gambaro, "Da via Panisperna a Frascati: gli acceleratori mai realizzati", *Quaderni di Storia della Fisica* 1 (1997): 319-33; Giovanni Battimelli, "Le origini del laboratorio di fisica", in *Atti del Convegno in onore di Domenico Marotta nel 25° anniversario della morte (Roma, 9 luglio 1999)*, "Memorie di Scienze Fisiche e Naturali, Rendiconti della Accademia Nazionale delle Scienze detta dei XL", serie V, vol. XXIII, parte II, tomo I (1999): 149-60.

6 See: Edoardo Amaldi, "Sulle ricerche di fisica nucleare eseguite a Roma nel quadriennio di guerra", *Ricerca scientifica e Ricostruzione*, January-February 1946: 6 ff.; Giovanni Battimelli, "Edoardo Amaldi", in *Enciclopedia Italiana*, VIII appendice, *Il contributo italiano alla storia del pensiero* (Roma: Istituto della Enciclopedia Italiana, 2013), 726-30. Francesco Guerra and Nadia Robotti have given presentations on this subject at the annual meetings of the Società Italiana di Fisica in Bari (2009) and Bologna (2010): I would like to thank them for their kindness in making those presentations available to me before the publication of their detailed work.

to which Bernardini could contribute the very special expertise acquired in this field while working in Florence with Giuseppe Occhialini and Bruno Rossi. Some of the younger researchers in the group demonstrated an extraordinary ability in developing very sensitive particle detectors. In this case, in addition, Lo Surdo was interested, and ready to lend a helping hand, as director of both the Physics Institute of the University and the Institute of Geophysics of the CNR, which was located inside the Institute.[7]

In this context, Piccioni and Conversi, and later on Pancini, started an experiment on the absorption of "mesotrons", a particle that had been recently identified in cosmic rays. At a very early stage of research, the area of San Lorenzo (adjacent to a railway yard of great strategic importance and very close to the Città Universitaria) was bombed by the Allies (over 1,000 casualties). Some buildings inside the campus were hit, and though the Physics Institute was not, the group decided that the equipment built for the detection of particles should be moved somewhere more unlikely to be bombed. The work went on in the basement of a high school, the Liceo Virgilio, at walking distance from the Vatican. The experiment itself had become for the group a symbol of their strong willingness to keep scientific activity alive, notwithstanding the difficult working conditions and even the personal risks involved in doing electronic measurements at night, secretly, challenging Nazi rules on curfew, while some of them took part in the Resistance. Their results were published in the *Nuovo Cimento* in 1944, and in the *Physical Review* at the end of the war, in 1947.[8] They are now widely acknowledged as a milestone in the history of particle physics.[9]

In the meantime, nuclear physics was gaining front-page attention, and the name of Fermi was reaching unprecedented renown in the public domain. At the end of World

7 Franco Foresta Martin and Geppi Calcara, *Per una storia della geofisica italiana. La nascita dell'Istituto nazionale di geofisica (1936) e la figura di Antonino Lo Surdo* (Milano: Springer Italia, 2010).

8 Marcello Conversi and Oreste Piccioni, "Misura diretta della vita media dei mesoni frenati", *Nuovo Cimento* 2 (1944): 40-70; Conversi and Piccioni, "Sulla disintegrazione dei mesoni lenti", *Nuovo Cimento* 2 (1944): 71-87; Marcello Conversi, Ettore Pancini and Oreste Piccioni, "On the Disintegration of Negative Mesons", *Physical Review* 71 (1947): 209-10.

9 The acknowledgement comes from the Nobel Prize in Physics 1968: Luis W. Alvarez, "Recent Developments in Particle Physics", Nobel Lecture, December 11, 1968, in *Nobel Lectures, Physics 1963-1970* (Amsterdam: Elsevier, 1972), 241; available at *Nobelprize.org*, Nobel Media AB 2014, http://www.nobelprize.org/nobel_prizes/physics/laureates/1968/alvarez-lecture.pdf, last accessed May 23, 2016. See also: Amaldi, *Da via Panisperna all'America*; Marcello Conversi, "L'intricata storia del muone" *Il Nuovo Saggiatore* 1 (1985): 33-40; Oreste Piccioni, "The Observation of the Leptonic Nature of the Mesotron by Conversi, Pancini and Piccioni", in *The Birth of Particle Physics*, ed. Laurie M. Brown and Lillian Hoddeson (Cambridge: Cambridge University Press, 1983), 222-41; Piccioni, "The Discovery of the Leptonic Property", in *Present Trends, Concepts and Instruments of Particle Physics: Symposium in honour of Marcello Conversi's 70th birthday, Rome, 3-4 November 1987*, ed. Marcello Conversi, Luciano Maiani, Giorgio Salvini, and Giustina Baroni (Bologna: SIF, 1988), 171-93.

War II, in Italy as elsewhere, "nuclear physicists" (the "nuclear" label covering a range of physics partly overlapping with applied nuclear research and partly belonging to particle physics)[10] were lobbying in favor of their activity, not only within bodies institutionally mandated to support academic research, but also with industrial circles and with the government. In fact, some of them (in particular Amaldi in Rome, and Giuseppe Bolla in Milan) had a clear vision of how these different milieus were closely knit, and how the CNR might play a key role in this game. Fermi, though now deeply involved in science policy in the United States, kept a supporting attitude in favor of his former pupils, offering – whenever he could – political and academic support, along with a few important pieces of strategic advice.

To make a long story short, in 1945 the CNR created a research center in the Physics Institute in Rome, the Centro per lo studio della fisica nucleare e delle particelle elementari. In 1946, Amaldi gained the support of Fiat to create a laboratory for the study of cosmic rays located by the Rome group at the Testa Grigia peak, in the Alps near mount Cervino. The most important development, however, was the expansion of this research beyond Rome. In 1947, a Centro per lo studio degli ioni veloci was established in Padua, and directed by Antonio Rostagni. In 1951 two more centers were created: one in Turin, directed by Gleb Wataghin, and one in Milan. Though labelled as "nuclear research" centers, their common ground was – at least until the mid-1950s – research on cosmic ray physics. These centers were formally dependent on the CNR, which funded them, but in fact were under the scientific control of the university institutes that "hosted" them. An unprecedented step took place in 1951, when the CNR established a national institute to coordinate their activity. It was the first time that a national institute of the CNR brought together centers belonging to different universities: such was the birth of the Istituto Nazionale di Fisica Nucleare, which would gain international renown in the following years under the acronym INFN.[11]

At that point, what had been at the beginning a survival strategy, and characterized later on as an effort to "rebuild" a tradition in line with the legacy of Fermi (whence it claimed legitimization facing other disciplinary groups and the government), had silently became something new. The community of "nuclear physics" researchers had taken the shape of a widespread national network of scientific relations and collaborations, in a

10 See: Alberto Cambrosio, "The Dominance of Nuclear Physics in Italian Scientific Policy", *Minerva* 23, no. 4 (1985): 464-84; Giovanni Battimelli, "Circulation of Ideas and Migration of Scientists: Hints from the Early Times of Nuclear Physics", in *The Migration of Ideas*, ed. Roberto Scazzieri and Raffaella Simili (Sagamore Beach: Watson, 2008), 195-201.

11 On INFN history: Giovanni Battimelli, Giovanni Paoloni, and Michelangelo De Maria, *L'Istituto Nazionale di Fisica Nucleare: Storia di una comunità di ricerca* (Roma: Laterza, 2001); Giovanni Battimelli, "I fisici in rete: l'INFN", *Scienza e società* 5-6 (September 2008): 26-33.

reframed institutional context. It was involved in first class international collaborations, it was on the frontline of research, and it was regarded as a leading group in Italian science policy, notwithstanding underlying potential conflicts that would become apparent in the following years.

Industry, Academia, and the Nuclear Program

Italian engineers and electricity companies, on their part, had never totally dropped their interest in producing energy from atoms. To understand the significance of an Italian nuclear program in a historical perspective, and its role in the socio-economic development of the country, it is necessary to consider the constraints imposed on Italian growth, from the last decade of the nineteenth to the end of the twentieth century, by the scarcity of energy resources. Hydroelectric production, which had been the prevailing source since the beginning of the electricity industry, was an important factor in the success of the industrialist shift of Italian economic policy in the 1890s. In the first two decades of the following century, Italian policymakers perceived the hydroelectric source as virtually unlimited, capable of freeing Italy forever from energy constraints caused by the poor quality and scarcity of its coal. Hydroelectricity was renamed "*carbone bianco*" ("white coal"). However, by the end of the 1920s, severe droughts and the growth in demand for electricity made it clear that this source had certain disadvantages and suffered from a limited increase potential. Italian engineers were therefore on the quest for non-fossil production sources for integration/substitution.

Fermi's remark of 1923 echoed now and again for two decades. In 1928, *L'Elettrotecnica* (a journal closely associated with the Italian electricity industry), in a letter from the editor, published under the headline "Centrali termiche o centrali idrauliche?" (Thermoelectric or hydroelectric power plants?), expressed this view: "While waiting for physics to succeed in providing humanity with new energy sources, perhaps with the disintegration of the atom, we must still use, in order to meet the continually increasing needs of our life today, those classic sources, which, as we learned in our school years, all use solar energy, but transform it differently".[12] A few days before Corbino's aforementioned speech, in September 1929, Marconi pointed to the production of energy from the atom as one of the three impending most important technological advances, together with television and the wireless transmission of energy (the only one of these prophecies that did not come true).[13] Again, in 1941

12 *L'Elettrotecnica* (1928): 1.

13 Interview with George Sylvester Viereck, for the news agency Korda Angloamerican Newspaper Service, Marconi Archives, Bodleian Libraries, Oxford, box 53/2. It is also worth mentioning that Marconi played a substantial role in the organization of the first congress of nuclear physics in Rome, in 1931.

L'Elettrotecnica published an article on nuclear energy, ending with these words: "In any event, though it is true that the energy produced by disintegration [of the atom] is not yet in direct competition with that produced by combustion, and even if this is not likely to happen in the very near future, it would be wrong for engineers to completely dismiss the possibility that one day they may be working on veritable 'power plants' for the exploitation of nuclear energy".[14]

At the end of World War II, the Organisation for Economic Co-operation and Development (OECD) refused to give Italian electricity companies any Marshall Plan funds for the further development of hydroelectric projects. It pointed out that only a substantial shift of the Italian electricity industry to thermoelectric production could deal with the energy demand needed to support the reconstruction of the country, and any further process of economic growth. Accordingly, the United States would only support such a transition.[15] Thermoelectric production (from oil, and no longer from coal) actually grew at such a pace to cover the acceleration of energy demand caused by reconstruction, the growth of industrial production and the improvement of Italian lifestyle standards. It finally prevailed over hydroelectricity in 1966. In addition, oil was then extremely cheap, which favored the transition, while hampering the development of any other production source by making it too expensive, with the exception of the upgrade of already existing hydroelectric and geothermic projects. An objection often made against nuclear energy investments.

The shift to thermoelectric power, however, made Italy increasingly dependent on oil imports: policymakers deemed it a temporary price for American support, and for the benefit of the looming "economic miracle", but in medium-term plans it would be necessary to find an alternative to oil. Such was the industrial perspective of the Italian nuclear program. It is worth noting, in addition, that a similar perspective was at the roots of the French nuclear program, adopted in 1947 by the Commissariat à l'énergie atomique et aux énergies alternatives (CEA) and the Électricité de France (EDF), the state-owned electricity company resulting from the nationalization of electricity in 1946.[16] France was often quoted by Italian nuclear researchers and nuclear energy sup-

14 E. Severini, "Accenni sulla costituzione della materia e sul problema del combustibile atomico", multiple part paper, published in *L'Elettrotecnica*, vol. XXVIII (1941): 11-14, 94-97, 118-21, 144-45, 169-71; qt. in Carlo Lombardi, "La questione dell'energia nucleare", in *Storia dell'industria elettrica in Italia*, vol. 5, *Gli sviluppi dell'ENEL.1963-1990* (Roma-Bari: Laterza, 1994), 589-644, see 589.

15 On energy policy in post-war Italy: Silvio Labbate, *Il governo dell'energia. L'Italia dal petrolio al nucleare (1945-1975)* (Firenze: Le Monnier, 2010); Elisabetta Bini, *La potente benzina italiana. Guerra fredda e consumi di massa tra Italia, Stati Uniti e Terzo mondo (1945-1973)* (Roma: Carocci, 2013).

16 See: Gabrielle Hecht, *Le rayonnement de la France. Énergie nucléaire et identité nationale après la Seconde guerre mondiale* (Paris: Éditions Amsterdam, 2014); Yves Bouvier, "La mutation nucléaire d'EDF", in *Histoires électriques. EDF a 70 ans* (Paris: Fondation EDF, Comité d'histoire de l'électricité et de l'énergie, 2016), 32-53.

porters as a model Italy might follow, as other "nuclear" countries (not only the United States, but also the United Kingdom and even the Soviet Union) were out of reach in terms of dedicated financial resources. They did not take into account, however, the fact that France was among the winners of World War II, therefore counting on nuclear technology assets and military implications unavailable to Italy.

In 1942, Fermi secretly built in Chicago the world's first nuclear reactor, later renamed the "Chicago Pile". This was a substantial step in the development of the first atomic bomb under the Manhattan Project, and at the same time laid the foundations for a true nuclear industry. Obviously, Italian researchers (including those in Rome) were unaware of what was going on on the opposite side of the Atlantic. As soon as Hiroshima and Nagasaki reached the newspaper headlines in August 1945, however, Amaldi and his fellow nuclear physicists became immediately conscious of the nature of the work Fermi had been doing. According to Giorgio Salvini, who would become President of INFN in the mid-1960s, "At that time there was enormous interest in nuclear issues. It is not surprising, really, if you consider that it was 1945; the atomic bomb aftermath immediately set people to thinking about the potential use of nuclear reactors to generate power".[17]

Salvini, at the time assistant in the Physics Institute of Milan's State University, was in touch with Carlo Salvetti, who taught theoretical physics in the same Institute, and with Mario Silvestri, a young physics graduate working in the Edison Company. They asked for advice from their professor, Giuseppe Bolla: it was he who suggested that the development of nuclear energy could become an opportunity to foster cooperation between academia and industry. To make a long story short, again, this led to the establishment, in November 1946, of a research company (Centro Informazioni Studi ed Esperienze, CISE) where the largest Italian industrial groups, some of them state-owned, potentially interested in the development of the nuclear industry, became associated, and cooperated with academic researchers from universities and the CNR.[18] To prevent the misuse of human and financial resources in a competition, which would have been pointless at that time and in that context, the CISE and university/CNR centers reached an agreement on the differentiation of research tasks, negotiated by Amaldi and Bolla.[19]

Bolla was appointed CISE's director, with the mandate of taking the necessary steps to build a "national nuclear reactor" for electricity production. To achieve that goal, a

17 Interview in Giovanni Paoloni, ed., *Energia, ambiente, innovazione. Dal Cnrn all'Enea* (Roma-Bari: Laterza, 1992), 52.

18 On CISE's history: Sergio Zaninelli, ed., *Ricerca, innovazione, impresa. Storia del CISE: 1946-1996* (Roma-Bari: Laterza, 1996).

19 Edoardo Amaldi, "Gli anni della ricostruzione", *Giornale di fisica* 20, no. 3 (1979): 186-225, see 194-96.

vast number of issues needed to be resolved, since nuclear technology was strictly classified in the countries that had it. In addition, there was a lack of qualified staff. Such were the issues that cooperation between academia and industry had to deal with. By the end of 1951, the CISE was successfully dealing with the issue of qualifying specialized researchers and staff. In addition, it had built a pilot plant to produce heavy water through electrolysis, and created an experimental uranium metallurgy plant. In its laboratories, measurements of uranium fission had been undertaken, and leading-edge electronic instruments had developed.[20] In January 1952, Bolla declared in CISE's magazine, *Energia nucleare*:

> As things currently stand at CISE, it is safe to say that Italy has the scientific grounding and key technologies to build an experimental pile. In other words, we have a core of specialists capable of rapidly understanding work undertaken by other researchers. … Established … as a platform for academia and industry to solve the problem of research in Italy, CISE has delivered on all of the work that it has carried out. … Where it has not delivered is attracting official interest in the efforts undertaken by industrialists, academics and researchers.[21]

Such a declaration marked a turning point in the tireless lobbying strategy that scientists and industry executives had put in place to win government recognition and funding.

Beyond (and Behind) Nuclear Energy

Governmental recognition came in June 26, 1952, with the establishment (as a special committee of the CNR) of the Comitato Nazionale per le Ricerche Nucleari (CNRN), which was the outcome of economic, academic and political negotiations that had been going on behind the scenes for six years.[22] What matters here is the fact that the procedure had been hampered by the political difficulty of balancing a number of conflicting interests. The major political issue in the background was the nationaliza-

20 Roberto Maiocchi, "Il ruolo della ricerca", in *Ricerca, innovazione, impresa*, ed. Zaninelli, 43-88.

21 Giuseppe Bolla, "Il Cise", *Energia nucleare* January 31, 1952, 19-20.

22 On the origin and activity of the CNRN: Giovanni Paoloni, "Gli esordi del nucleare", in *Storia dell'industria elettrica in Italia*, vol. 4, ed. Valerio Castronovo, *Dal dopoguerra alla nazionalizzazione. 1945-1962* (Roma-Bari: Laterza, 1994), 383-408; Leopoldo Nuti, *La sfida nucleare* (Bologna: il Mulino, 2007), 53-70; Barbara Curli, *Il progetto nucleare italiano (1954-1962). Conversazioni con Felice Ippolito* (Soveria Mannelli: Rubbettino, 2000); for a less academic narrative: Giovanni Paoloni, *Il nucleare in Italia* (Roma: PRC, 2009), available at https://www.enel.it/it-it/Documents/azienda/sostenibilita/Nucleare_Enel_1_interattivo.pdf, last accessed May 23, 2016.

tion of the electricity industry. Who would make the final decision on the building of a nuclear plant? Major private players in the electricity industry feared that the need for state control over nuclear energy, though it could not be denied, might be used as a further pretext in favor of nationalization, as would the need for state funding. Half of the electricity industry, however, was already controlled by major companies belonging to the state-owned Finelettrica, the electricity financial holding of the Istituto per la Ricostruzione Industriale (IRI) Group, while other parts consisted of local council-owned electricity companies, and – not least important – "auto-producers" (among them, state railways). Moreover, on the Italian energy market there was another (controversial) state-owned player, the oil company Azienda Generale Italiana Petroli (AGIP), soon to become an industrial holding (Ente Nazionale Idrocarburi, ENI) involved in oil, petro-chemistry and gas, and aspiring to become the take-all state-owned player in energy, including electricity. Actually, in the mid-1950s nuclear energy would become precisely the ground where IRI and ENI would start competing, and behind the scenes conflicting.

In addition, other issues were also at stake. How should research and development in the nuclear energy industry be balanced with "fundamental" physics research? Should a future nuclear agency be controlled by the Ministry of Industry or the Ministry of Education (or both, somehow)? Which role would the CNR play? How should substantial state funding for "fundamental" research be secured? How far should the coverage of the "nuclear" label be extended to "fundamental" physics? With such issues in mind, physicists took part in the negotiations, and in fact, the establishment of INFN in 1951 must be regarded as a substantial move in their game. Securing funding was the prominent issue uniting the community under the "nuclear physics" label in the 1950s. However, there was an underlying competition on academic power, which in the 1960s would split that same community along different positions: political (nationalization pro/con), geographical (North/South, Rome/Milan), technical (fundamental/applied research), disciplinary (high-energy/solid state physics).

After its establishment, the CNRN funded the creation of a center for applied nuclear research in Ispra, in northern Italy. The CISE was the contractor for this center, which hosted the experimental reactor whose design and building was its mission since inception in 1946. In 1953-1954, however, US President Dwight D. Eisenhower inaugurated the Atoms for Peace program, also involving the United Nations. The CISE's mission was refocused on building the experimental reactor under a contract with a US firm, AC&F. The idea was to take advantage of the availability of commercial technologies, adapting them to a new research and development context. However, this strategy shift was the first step on a path which would lead in a short time to a break in relations between the CNRN and the CISE. In 1957, the CNRN took on directly the building of the center in Ispra, to hand it over to the newly established Euratom as a Joint Research Center, immediately after the reactor went critical in 1959. In 1958, the CNRN started building a new center, in Casaccia near Rome, where it relocated the activities bound to leave the Ispra center. This move also fueled resentment among physicists working in northern Italy, who felt deprived of what they regarded as their common research facility.

While trying to promote applied research and the development of nuclear power in Italy, the CNRN also subsidized "fundamental" research through the INFN (in fact more or less 20 per cent of the budget), and took charge of the Italian participation in a newly established European research facility, the Centre Européen pour la Recherche Nucléaire (CERN). The INFN quickly expanded its network through the creation of centers and sections in most Physics Institutes at different universities, while taking on the task of creating national research facilities for the use of all its associated groups. The first of these was the electro-synchrotron built in Frascati, near Rome, which started its activity at the end of the 1950s. Immediately after its inauguration, researchers in Frascati designed and prototyped an innovative accelerator, ADA, the first-ever storage ring. The INFN was a promoter of the project to design and build a "national" computing machine (the Calcolatrice Elettronica Pisana, CEP) and the establishment of related facilities in cooperation with the CNR and with industry (Olivetti).

In the meantime, three nuclear power plants were under construction, two in southern[23] and one in northern Italy. In addition, the CNRN supported research in plant genetics at the Casaccia center, and in molecular biology through the establishment of an International Laboratory in Naples, cooperating with the CNR.[24] In 1960, the CNRN, after new political and institutional conflicts, became the Comitato Nazionale per l'Energia Nucleare (CNEN), a government agency independent from the CNR. Felice Ippolito,[25] the prominent operative member of the CNRN since its inception, was appointed secretary general (in fact, chief executive officer). The CNRN also funded education and training, in different universities, for nuclear engineers, nuclear physicists, and technical staff, and supported other activities in what is nowadays called Sci-

23 Barbara Curli, "Energia nucleare per il Mezzogiorno. L'Italia e la Banca Mondiale, 1955-1959", *Studi Storici* 37, no. 1 (1996): 317-51; Mauro Elli, *Atomi per l'Italia. La vicenda politica, industriale e tecnologica della centrale nucleare ENI di Latina 1956-1972* (Milano: Unicopli, 2011); Anna Rita Rigano, *La Banca d'Italia e il progetto ENSI. Fonti per la storia dello sviluppo energetico italiano negli anni Cinquanta nelle carte dell'Archivio della Banca d'Italia*, "Quaderni dell'Ufficio ricerche storiche", 4 (June 2002).

24 Interview with Gian Tommaso Scarascia Mugnozza, in *Energia, ambiente, innovazione*, ed. Paoloni, 184-91; Francesco Cassata, *L'Italia intelligente. Adriano Buzzati-Traverso e il Laboratorio internazionale di genetica e biofisica* (Roma: Donzelli, 2013), 77-143, 262-319.

25 On Felice Ippolito: Curli, *Il progetto nucleare italiano*; and more recently: Pietro Greco, "La battaglia di Felice Ippolito", *Le Scienze* 566 (October 2015): 70-77.

ence and Technology Studies. In fact, the CNRN had become the focal structure of a network of relations between academia, the industry, and policymakers, who shared a vision of the future of Italy.[26] It was a very promising landscape, notwithstanding looming academic tensions, and open political conflict with private electricity majors. However, the sky was clouding over.

The "Ippolito Affair" and Its Consequences on Science and Industry

By the end of the 1950s, the US attitude to the Italian nuclear program, which had been very positive after the take-off of the Atoms for Peace program, became covertly hostile. The reasons for this shift have been the object of much speculation, but only recently have they been investigated by academic research. No consensus has been reached yet. In 1963-1964, shortly after the electric nationalization, Ippolito was involved in alleged mismanagement of State funding to the CNRN-CNEN. The subsequent "affair" slowed the pace of Italy's nuclear program, with only one nuclear plant being built since then, in 1980: and this was the last one. Moreover, from the early 1970s, "green" movements appeared on the Italian political scene, first rallying against hydroelectric power plants, then against nuclear ones.

With all its shortcomings, the nuclear program had been an important driver for industrial innovation and scientific research in Italy, well beyond the boundaries of closely related fields. Its crisis hit Italian research. In addition, the slowing pace of the program had a very hard impact on the Italian electromechanical industry, where the IRI-owned Ansaldo Meccanico Nucleare (AMN)[27] had been making large investments. After the oil crisis of 1973, the Italian government adopted an energy plan based on the massive building of nuclear power plants. To minimize environmental risks, and downplay potential conflicts between industrial actors, a standardized national project for nuclear reactors (Progetto Unificato Nazionale, PUN) was adopted. Though the energy plan was clearly unrealistic, the industrial stakeholders of the nuclear program had prepared themselves for the reasonable perspective of building at least a part of those plants. In fact, only one plant was actually built, and the resulting unbalance was a major factor in the subsequent crisis of the IRI-Finmeccanica group. When a new start of the Italian nuclear program took place in 2008, it was first hindered by conflicts between its prospective actors, and then definitely stopped, in 2011, by the negative reactions to the

26 Giovanni Paoloni, "Lo sviluppo scientifico italiano nell'ultimo sessantennio: due modelli a confronto", *Meridiana* 54 (2005): 39-61; Cassata, *L'Italia intelligente*, 145-91.

27 Barbara Curli, "Il nucleare", in *Storia dell'Ansaldo*, vol. VIII, *Una grande industria elettromeccanica, 1963-80*, ed. Valerio Castronovo (Roma-Bari: Laterza, 2001), 109-42.

Fukushima accident, followed by a new referendum. In the last fifteen years, however, the denationalization of the electric industry and its process of internationalization in a European framework have conspicuously challenged the energy landscape and policies, changing the context of the Italian "nuclear" debate.

Lodovica Clavarino

"Many Countries Will Have the Bomb: There Will Be Hell":* Edoardo Amaldi and the Italian Physicists Committed to Disarmament, Arms Control and Détente

The aim of this chapter is to analyze Edoardo Amaldi's strong commitment to disarmament and détente in Italian society during the Cold War years. One of the most famous Italian physicists of the twentieth century, Amaldi (1908-1989) grew up in the extraordinary environment of the via Panisperna boys. In addition to being a well-known nuclear physicist, during the Cold War he became a representative of a group of scientists, who felt a "moral duty" to devote their time and their expertise in making people aware of the dangers of the nuclear age and – at the same time – urging governments to engage in arms control.

This research is mainly based on the papers of the Archivio Amaldi, stored in Rome at the Department of Physics of the University "La Sapienza". Besides these archival sources, this chapter is built on some publications about Amaldi's life,[1] as well as on historiographical works on international movements, the Cold War and Italian history. Other key sources are the memoirs and biographies of some of Amaldi's friends and colleagues[2] and the conversations I had with a few of them.[3] The issue of transnational net-

* Edoardo Amaldi, in Alberto Ronchey, "'L'ultima occasione per il mondo di fermare la catastrofe nucleare: Intervista con i fisici Amaldi e Calogero'", *La Stampa*, February 24, 1967, 1.

1 Edoardo Amaldi, *Da via Panisperna all'America. I fisici italiani e la Seconda guerra mondiale*, ed. Giovanni Battimelli and Michelangelo De Maria (Roma: Editori Riuniti, 1997); Carlo Rubbia and Piero Angela, *Edoardo Amaldi, scienziato e cittadino d'Europa* (Milano: Leonardo Periodici, 1992); Fernando Ferroni, ed., *The Legacy of Edoardo Amaldi in Science and Society*, Proceedings of the Conference held in Rome, 23-25 October 2008 (Bologna: S.I.F., 2010).

2 Regarding the members of the "Via Panisperna Group" see: Laura Fermi, *Atoms in the Family: My life with Enrico Fermi* (Chicago: Unversity of Chicago Press, 1954); Giuseppe Bruzzaniti, *Enrico Fermi: il genio obbediente* (Torino: Einaudi, 2007); Emilio Segrè, *Autobiografia di un fisico* (Bologna: il Mulino, 1995); Simone Turchetti, *Il caso Pontecorvo. Fisica nucleare, politica e servizi di sicurezza nella guerra fredda* (Milano: Sironi, 2007); Miriam Mafai, *Il lungo freddo. Storia di Bruno Pontecorvo, lo scienziato che scelse l'URSS* (Milano: Mondadori, 1992); Valeria Del Gamba, *Il ragazzo di via Panisperna. L'avventurosa vita del fisico Franco Rasetti* (Torino: Bollati Boringhieri, 2007); Carlo Bernardini, Luisa Bonolis, Maria Grazia Melchionni et al., *Fisici italiani del tempo presente: storie di vita e pensiero* (Venezia: Marsilio, 2003).

3 Prof. Francesco Calogero, conversation with author, June 10, 2008, Roma; Prof. Carlo Schaerf, conversation with author, June 27, 2008, Roma; Prof. Ugo Amaldi (Edoardo's son, and physicist himself), email exchange with author, 2013-14.

works has been outstandingly addressed by Lawrence Wittner and Matthew Evangelista,[4] the case of Pugwash has been described in detail by Joseph Rotblat (one of its founding members),[5] and the available bibliography about some prominent scientists is plentiful.[6] However, despite the current growing interest in nuclear history, the analysis of the personalities and organizations involved in the various nuclear disarmament campaigns is still in its infancy. In my opinion it is useful to explore other perspectives beyond the prevalent "political-diplomatic framework" of nuclear history, enhancing the research about international movements and associations committed to the arms control process.

This chapter is divided into three parts: the first one addresses the early years of Amaldi's professional life in the via Panisperna group, the second one deals with the beginning of his "civil commitment," and the third one describes the Non-Proliferation Treaty (NPT) debate as a significant case study of Amaldi's engagement in arms control issues.

The via Panisperna Years: From an International Success to "an unbelievable collapse"[7]

As mentioned above, Amaldi's education took place in the exceptional context of the via Panisperna group, the scientific team led by Enrico Fermi in Rome from the mid-1920s to the second half of the 1930s, when the tightening of the Fascist regime after the introduction of the Racial Laws in 1938, and then the outbreak of World War II, forced many of its members to leave Italy. This group quickly reached a high level of international prestige, collaborating with the most important research centers at the time – like those of Frédéric Joliot-Curie in Paris, Niels Bohr in Copenhagen, Werner

4 Lawrence Wittner, *The Struggle against the Bomb*, vol. 1, *One World or None: A History of the World Nuclear Disarmament Movement through 1953* (Stanford: Stanford University Press, 1993), vol. 2, *Resisting the Bomb: A History of the World Nuclear Disarmament Movement, 1954-1970* (Stanford: Stanford University Press, 1997), vol. 3, *Toward Nuclear Abolition: A History of the World Nuclear Disarmament Movement, 1971 to the Present* (Stanford: Stanford University Press, 2003); Matthew Evangelista, *Unarmed Forces: The Transnational Movement to End the Cold War* (Ithaca: Cornell University Press, 1999).

5 Joseph Rotblat, *Science and World Affairs: History of the Pugwash Conferences* (London: Dawsons of Pall Mall, 1962); Rotblat, *Scientists in the Quest for Peace* (Cambridge: The MIT Press, 1972). Joseph Rotblat, Daisaku Ikeda, *A Quest for Global Peace: Rotblat and Ikeda on War, Ethics and the Nuclear Threat* (London: I.B. Tauris, 2007).

6 Besides those quoted above, we mention here the autobiography of another Italian: Bruno Rossi, *Momenti nella vita di uno scienziato* (Bologna: Zanichelli, 1987); and the book about the well-known Hungarian-American physicist Leo Szilárd: Leo Szilárd, *La coscienza si chiama Hiroshima. Dossier sulla bomba atomica*, ed. Gertrud Weiss Szilárd and Spencer R. Weart (Roma: Editori Riuniti, 1985).

7 Edoardo Amaldi, "The Italian Team", interview with Domenico De Masi, *Rivista IBM* 3 (July 8, 1986): n. p. Amaldi's expression, in Italian, is "uno sfascio che non si può descrivere".

Heisenberg in Berlin, Ernest Rutherford in Cambridge, and Robert Oppenheimer in the United States – and contributed to the groundbreaking findings achieved by nuclear physics during that period.[8] The members of the group (Fermi, Franco Rasetti, Emilio Segrè, Bruno Pontecorvo, Ettore Majorana and Amaldi) were all extremely young and had a very good personal relationship with each other. Because of this synergy among them, many scholars wrote then about the "school" of Rome, at a time when teamwork in science was not significantly widespread yet. The end of this fruitful cooperation, due to the different paths taken by the via Panisperna boys during Fascism and then the war, was a dramatic event for all of them.

The story of the via Panisperna boys is closely linked to the "brain drain" of Jews and political opponents from the European countries ruled by Nazi-fascism, mainly to North America. Many scientists left Italy for racial or political reasons, and Amaldi himself was tempted by this prospect.[9] However, he decided to stay in his country and, as the only "survivor" of the original team, worked to safeguard a future for Italian scientific research.[10] Therefore, Amaldi spent the war period in Italy, with few colleagues and a lack of financial resources, while the international communications with his old friends became abruptly impossible because of the outbreak of the conflict.

Choosing to stay in Italy during the war (despite his strong opposition to Fascism), Amaldi did not have the opportunity – as many of his former workmates had – to participate in the Manhattan Project. During the war, Amaldi was almost certain that some of his former colleagues were involved in the American military project to build an atomic bomb (led mainly by the fear of a parallel German effort).[11] Nevertheless, his hypothesis was confirmed only at the end of the war, with the resumption of normal communications between Italians and Americans.[12] Some years later, in several interviews and personal recollections, Amaldi wrote that as soon as he learned about Hiroshima over the radio, he became immediately anxious about the long-term effects of this event.[13]

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8 In 1935 the group obtained an important patent on artificial radioactivity. Giovanni Battimelli, Giovanni Paoloni, and Michelangelo De Maria, *L'Istituto Nazionale di Fisica Nucleare. Storia di una comunità di ricerca* (Roma: Laterza, 2001).

9 Edoardo Amaldi, "Il caso della fisica", in *Conseguenze culturali delle leggi razziali*, Conference held at the Accademia nazionale dei Lincei, Roma, 1988 (Roma: Accademia nazionale dei Lincei, 1990), 107-33; Roberto Fieschi, "I fisici italiani e la questione atomica", in *La cultura della pace dalla Resistenza al Patto Atlantico*, ed. Massimo Pacetti, Massimo Papini, and Marisa Saracinelli (Bologna: Il Lavoro Editoriale, 1988).

10 Edoardo Amaldi, "Gli anni della ricostruzione", *Giornale di Fisica* 20, no. 3 (1979): 186-225. Amaldi himself used the words "scientifically survive" to describe that period.

11 Rubbia and Angela, *Edoardo Amaldi*, 144, 160-61.

12 Enrico Fermi, Letter to Edoardo Amaldi, August 29, 1945, Archivio Amaldi, Dipartimento di Fisica, Università "La Sapienza", Roma (hereafter AAm), sezione Eredi (hereafter SE), box 1, folder 1/5.

13 Edoardo Amaldi, "Ricordi di un fisico italiano", *Giano. Ricerche per la pace* 1 (1989): 87-89; Edoardo Amaldi, "Manuscript on the Atomic Bomb", n.d., AAm, SE, box 8, folder 7.

The experience of the war period is crucial to understand his attitude, in a time marked by an increasingly complex link between science and politics, due to the beginning of the nuclear age. The explosion of the two atomic bombs in Japan in August 1945 represented a turning point, not only for the war and the international order, but also for the evolution of Amaldi's personality. After the conflict, he stated many times that he felt lucky and relieved not to have been involved in any military nuclear projects.[14] As we can see from some documents, Amaldi's postwar mindset was consistent with his behavior during the conflict. As a matter of fact, in 1941 he intentionally diverted the research being carried out in the Physics Department of the University of Rome from studies that could be exploited for war purposes to different kinds of experiments.[15] According to the primary sources, the 1941 decision seems to have been above all a "political" one, since Amaldi was afraid of being involved in a military program led by the fascist regime or in a scientific partnership with German scientists under the Nazi regime. After hearing about the Allied nuclear bombings of Japan, which he later described as "days of intense dismay",[16] Amaldi began to actively think about the role scientists might have in the new international context shaped by the "nuclear dimension".

"If the peril is understood, there is hope":[17] The Scientific Community Claims a New Role

Amaldi stated many times that if, during the war, he had found himself in the situation faced by those colleagues who had been forced to emigrate – sometimes even suffering the murder of their own relatives by the Nazi-fascists – he would have probably participated in the Allied nuclear project as well.[18] The idea that in extreme situations even pacifist people could contribute to despicable projects led Amaldi to devote part of his time to the issue of nuclear disarmament. Although he never faced the ethical dilemma of a personal involvement in military research, Amaldi was persuaded that nuclear scientists, because of their technical knowledge and a sort of "common responsibility", had a duty to commit themselves to arms control and disarmament. Shortly after the war, he embraced the "new thinking" emerging from the dramatic experience of the war, well summarized in the pacifist slogan, "One world

14 Amaldi, "Manuscript".

15 Amaldi, *Da via Panisperna all'America*, 89-90.

16 Amaldi, "Manuscript".

17 "The Russell-Einstein Manifesto", July 9, 1955, *Pugwash Conferences on Science and World Affairs*, http://pugwash.org/1955/07/09/statement-manifesto/#more-1784, last accessed February 18, 2016.

18 See for example: Amaldi, "Manuscript"; Rubbia and Angela, *Edoardo Amaldi*, 91-92, 161-63; Edoardo Amaldi, *Journal de Physique*, colloque C 8, supplément au n. 12, tome 43 (décembre 1982).

or none", which highlighted that the dangers of the nuclear era needed a transnational commitment to save humanity from the risk of nuclear destruction.[19]

In 1956-1957 he received, as the only Italian addressee, several letters from Bertrand Russell on behalf of the subscribers of the Russell-Einstein Manifesto[20] – released to the public the previous year. Russell invited him to join a meeting aimed at exploring the idea of establishing an association of scientists that could strive for nuclear disarmament and overcome Cold War divisions.[21] Although he was unable to attend the first conference, which took place in Pugwash (Canada) in 1957, Amaldi immediately championed the initiative, being persuaded that the challenges of the nuclear age required a network that went beyond national borders.[22] The first Pugwash conference Amaldi was able to attend was the 1958 one, and his involvement in the movement was especially strong from 1962, when he was elected to the prestigious Continuing Committee,[23] up to 1972 when, because of his wife's illness, he significantly reduced his international activities. Even after this period, he remained actively committed to disarmament and peace issues, and worked to pass these values on to the new generations.

Amaldi believed that a well-informed public opinion should become a key player in modern societies, since one of the dangers of the nuclear age was citizens' unawareness of the perils of the present times, and their blind support for their governments' security policies. According to him, in Italy there was a strong need to inform public opinion, in order to counterweight an early widespread indifference about nuclear issues.[24] In the postwar period, Italian politics paid "limited" attention to nuclear matters, probably because of what the atomic age implied for the country, namely an Italian subordinate role in the international system, as a "junior" state weakened by the war and submitted to the decisions of its more powerful allies.[25]

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19 Wittner, *The Struggle against the Bomb*, vol. 1, *One World or None.*

20 Sandra Ionno Butcher, *The Origins of the Russell-Einstein Manifesto* (Washington: Pugwash Conferences on Science and World Affairs, 2005), https://pugwashconferences.files.wordpress.com/2014/02/2005_history_origins_of_manifesto3.pdf, last accessed 18 February 2016.

21 Bertrand Russell, Letter to Amaldi, August 29, 1956, AAm, sezione Dipartimento di Fisica (hereafter SADF), box 157 bis, folder 1/18; Russell, Letter to Amaldi, February 8, 1957, AAm, SE, box 11, folder 3.

22 Amaldi, Letter to Russell, November 6, 1956, AAm, SADF, box 157 bis, folder 1/18.

23 From the correspondence between Rotblat and Amaldi, we learn that Amaldi felt very honored for the prestigious assignment, but at the same time he didn't want to neglect his main interest, namely his teaching activity at the University of Rome. Joseph Rotblat, Letter to Amaldi, September 13, 1962, AAm, SADF, box 263, folder 5; Amaldi, Letter to Rotblat, September 20, 1962, AAm, SADF, box 263, folder 5.

24 About the widespread indifference on nuclear issues in Italy see for example: Enrico Persico, Letter to Bruno Rossi, December 24, 1946, in Amaldi, *Da via Panisperna*, 181-82.

25 Leopoldo Nuti, *La sfida nucleare. La politica estera italiana e le armi atomiche, 1943-1991* (Bologna: il Mulino, 2007), 27.

Things partly changed in later years, mainly due to the nuclearization of the North Atlantic Treaty Organization (NATO) forces deployed in Europe,[26] which raised anti-nuclear feelings in most European societies and spurred scientists to become politically active. This course affected Italy as well, especially after the first US nuclear warheads were deployed on its territory in 1957.[27] The organization of the first Perugia-Assisi anti-nuclear march in 1961, along with other campaigns, witnessed an increased interest in nuclear matters.[28] This marked a shift from a previous indifference and a sort of "removal" of the nuclear question toward the gradual emergence of an "atomic obsession", due to the fear linked to nuclear testing and proliferation.[29]

In such a new international context, from the 1960s on, for a large part of the scientific community it was no longer possible to remain aloof from society, in the quiet isolation of an "ivory tower". Therefore Amaldi considered it natural to be personally involved in the national and international context, in order to help citizens and governments to "understand the perils" of nuclear power (as stated in the Russell-Einstein Manifesto).

Italian Physicists as Advocates for Nuclear Disarmament and Arms Control

Although Amaldi's efforts to foster disarmament and promote a thaw between the superpowers characterized his entire life (from the postwar period to the late 1980s), the NPT represents undoubtedly an interesting lens to investigate the role he played, together with other scientists, in criticizing the viewpoint of leading politicians and diplomats. In the mid-1960s many physicists started to claim a voice in Italy's security policy. However, it is misleading to merely speak about a "politicization" of scientists, since their background was very heterogeneous and Amaldi himself was not closely related to any Italian political party. He supported the short-lived Partito d'Azione, a center-left party active in Italy from 1942 to 1947, and after the war his ideas were close to those of the Partito Repubblicano Italiano (PRI), led by Ugo La Malfa, although he never became a militant member.[30]

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26 Marc Trachtenberg, *History & Strategy* (Princeton: Princeton University Press, 1991), 153 ff.

27 Nuti, *La sfida nucleare*, 92 ff.

28 Witner, *The Struggle against the Bomb*, vol. 2, *Resisting the Bomb*, 235-38.

29 Massimo De Giuseppe. "Gli Italiani e la questione atomica negli anni Cinquanta", *Ricerche di storia politica* 1 (2000): 29-51, esp. 31-33.

30 Giovanni Battimelli in Battimelli, Paoloni, De Maria, *L'Istituto Nazionale di Fisica Nucleare*, ix; Lanfranco Belloni, *Da Fermi a Rubbia. Storia e politica di un successo mondiale della scienza italiana* (Milano: Rizzoli, 1988), 46.

Between the late 1960s and the mid-1970s, Amaldi's efforts had a double aim: to increase public opinion's awareness about the dangers of nuclear proliferation, and to organize a lobby that could facilitate Italy's accession to the NPT. Amaldi was convinced of the importance of starting an international negotiation about arms control and disarmament. According to him, only a dialogue between the two blocs could lay the foundations for a stable détente and a pacific world. A general and complete disarmament would have to be achieved through gradual but steady diplomatic talks on arms control. Therefore, Amaldi considered the Limited Test Ban Treaty (LTBT) of 1963 a useful first step, although he was convinced of the need to continue working on this path, since proliferation had become the most urgent international issue to be addressed.[31]

In 1965, a Pugwash Conference (the fourteenth) took place for the first time in Italy and that same year the Italian Pugwash Group was formally established. Its relevance was made clear by the foundation in 1966 of the International School on Disarmament and Research on Conflicts (ISODARCO), an NGO that is still active in the field of education on security problems, through the organization of annual residential courses.[32] The main pillars of the Italian Pugwash Group included Francesco Calogero, who probably has written more than anybody else about security and arms control, and Carlo Schaerf, who with Amaldi founded ISODARCO, and is still its Director.

In this context, Amaldi became increasingly concerned about the growing number of nuclear states (after the Soviet Union in 1949, the United Kingdom in 1952 and France in 1960, Communist China tested its atomic bomb in 1964), and highlighted the need to start a serious arms control process, in order to prevent other countries from "going nuclear". Together with other members of the Pugwash Continuing Committee, in 1967 he issued a declaration urging governments to sign an international agreement on this matter, which at the time was being debated in Geneva.[33] This issue was a very thorny one, because of the symbolic meaning that participating in the "atomic club" had for every nation, in terms of political status. Furthermore, after Moscow's achievement of a strategic parity with the United States, and the failure of some nuclear-sharing projects debated in NATO during the 1950s and 1960s,[34] Italy and other European

31 Edoardo Amaldi, RAI broadcast, January 20, 1964, "Il convegno dei cinque. Quale contributo può dare la scienza alla soluzione dei problemi del disarmo?", in AAm.

32 For more information about the history and activities of ISODARCO: http://www.isodarco.it/index.html, last accessed February 18, 2016; Carlo Schaerf, "Amaldi and ISODARCO", *Quaderni di storia della fisica* 7 (2000): 145-48.

33 "Draft of a Statement by the Pugwash Continuing Committee on the NPT", 1967, AAm, sezione Dipartimento (hereafter SD), box 40, folder "Non proliferazione"; Francesco Calogero, "Amaldi and Pugwash", *Quaderni di storia della fisica* 7 (2000): 137-44, esp. 142.

34 Here we refer mainly to the Multilateral Force proposal and the secret 1957 trilateral project among France, the Federal Republic of Germany and Italy.

countries felt increasingly unsure about the reliability of America's nuclear guarantee and strove to gain some control over the Western nuclear arsenal. Moreover Italy, like other potential "threshold-states", apart from criticizing the treaty for its unfair nature (too weak toward the nuclear powers and the "vertical proliferation" issue), was also afraid that the NPT could damage its industrial capacity and hinder the European integration process.[35]

Despite American pressures, the Italian government, led by Aldo Moro with Amintore Fanfani as Foreign Minister (both from the Democrazia Cristiana), was therefore cautious about assessing the treaty, and looked for a balance between different positions.[36] After Italian politicians and diplomats initially supported a non-proliferation agreement and advanced some original proposals – such as the 1965 idea of a moratorium for non-nuclear states in exchange for a real nuclear disarmament from nuclear powers – the domestic debate about the NPT reached an impasse.[37] Egidio Ortona – the Italian Ambassador in the United States – in November 1967 wrote in his diary: "We don't know who we must disapprove of most: the Americans who continue forcing us toward this arrangement or the Italians, who constantly oppose reservations".[38]

For Italy (as for other middle states) the debate on the NPT had to do more with the country's international status and diplomatic power, than with real security concerns; nevertheless, the debate about the treaty became incredibly polarized. In 1967, as soon as a joint NPT draft was proposed in Geneva by the Soviet Union and the United States, Amaldi gathered a group of eighty-six Italian scientists in order to write an appeal aimed at persuading the Italian government to join the treaty.[39] In their statement, scientists rejected the most common criticisms about Italy's accession to the treaty and argued that signing the NPT would translate into an increase – and not a reduction - of Italian security, given that the agreement could reverse the dangerous trend of global nuclear proliferation. The subscribers were persuaded that – as scientists – they were in a better position to assess the perils deriving from the dissemination of nuclear weapons. They thus appealed to the Foreign Minister hoping that he would undertake the necessary steps to ratify the treaty.

35 Paolo Cacace, *L'atomica europea. I progetti della guerra fredda, il ruolo dell'Italia, le domande del futuro* (Roma: Fazi, 2004), 116-18.

36 Nuti, *La sfida nucleare*, 287 ff.

37 Emilio Bettini, *Il Trattato contro la proliferazione nucleare* (Bologna: il Mulino, 1968); Luisa Calogero La Malfa and Ennio Ceccarini, ed., *Contro la proliferazione delle armi nucleari. Libro Bianco* (Roma: Edizioni della Voce, 1967).

38 Egidio Ortona, *Anni d'America*, vol. 3, *La cooperazione, 1967-1975* (Bologna: il Mulino, 1989), 52.

39 "Open Letter to Foreign Minister Amintore Fanfani", February 15, 1967, AAm, SD, box 40, folder "Non proliferazione".

The importance of this appeal should be understood in the context of various initiatives carried out at the same time by the Italian community of physicists. These included several interviews published in Italian newspapers such as *La Stampa* (Amaldi and Calogero, 1967), *L'Espresso* (Amaldi and Adriano Buzzati-Traverso, 1967) and *L'Europeo* (Amaldi again with Calogero, 1974), some press conferences, debates and workshops aimed at publicizing the positive aspects of the NPT, and in 1967 support for an official pronouncement issued by the PRI (at that time one of the ruling coalition parties). As is clear from the sources, the activities of these Italian physicists were conceived in the framework of an international effort to achieve a more secure world, less affected by weapons of mass destruction. As a member of the Pugwash Continuing Committee, Amaldi often informed the Secretary General about the Italian debate on the NPT, considering "a coordinated action in the various countries in support of the treaty highly desirable".[40] As we can read in one letter written by a prominent American Pugwash member, the activities led at that time by Italian physicists appeared to be internationally appreciated for their "promptness and intensity".[41]

The most famous document among these is perhaps the interview to Amaldi and Calogero, published on February 24, 1967 on the front page of the Italian newspaper *La Stampa*. Here, Amaldi emphasized two main dangers deriving from nuclear proliferation: the risk that nuclear weapons could be controlled by the "less reliable governments" of the world, and the risk that "atomic accidents" could happen, because of technical or political errors. As Amaldi stated:

> Within a few years, many countries will have the bomb, which will be controlled by the less reliable governments too. There will be a propagation chain. Each country with the bomb will induce the neighboring country to equip itself with the same weapons. There will be Hell. Sooner or later these weapons will be involved in local conflicts in the most unstable regions of the world. The risks of atomic accidents due to technical or political errors would be multiplied. Furthermore, it has never happened that the military renounce using any effective weapon. And the atomic bomb is effective, materially and psychologically.[42]

Although the main political parties and a large part of Italian public opinion were in favor of the NPT, there was a general opposition, which was difficult to overcome.[43] In addition to some small nationalistic groups (especially extreme rightists), the fiercest critics of the NPT included some key personalities such as Roberto Ducci and Roberto

40 Amaldi, Letter to Rotblat, March 8, 1967, AAm, box 503, folder 1.

41 Bernard T. Feld, Letter to Carlo Schaerf, March 12, 1967, AAm, box 503, folder 1.

42 Amaldi in Ronchey, "'L'ultima occasione'".

43 This point was particularly stressed by Carlo Schaerf; Schaerf, conversation with author.

Gaja, two of the most important Italian diplomats at that time, and Achille Albonetti, Foreign affairs Director of the Comitato Nazionale per l'Energia Nucleare (CNEN).[44]

In order to understand the intensity of the debate it is interesting to quote some words from a letter sent in February 1967 by Calogero to the US Chairman of Pugwash, Bernard Feld (both later became Secretary General). Reporting to Feld about the Italian situation, Calogero described "the hard work of the scientists to counter this sudden twist of the Italian stance on the policy of arms control and disarmament".[45] And then he stated:

> I have the impression that a large influence is to be traced to rather obscure personal intrigues of a number of high-placed diplomats, plus the ambiguous personality of our Foreign Minister. These maneuvers have been helped by the general and total innocence of our politicians concerning these problems. … We have intervened to counterbalance the misleading effects of a nasty and well-organized campaign mounted to scare public opinion away from the treaty.[46]

If the words used by physicists against the opponents of the NPT in the interviews, conferences and letters appear undoubtedly strong, it is also true that their "enemies" in this political battle were equally aggressive. The tone of the debate is clear if one looks at Albonetti's books, which include several harsh remarks on the scientists, described as being "often influenced by the Communist left and the radical environment…who defamed high officials of the Foreign Ministry" and "conducted a sensationalist political and press campaign" supporting "in an insidious and superficial way … such an absurd and unfair event" as the NPT.[47]

Similarly to 1967, in 1974 a group of Italian scientists (this time one hundred and forty-two), addressed a new open letter to the Foreign Minister pushing him to promptly ratify the treaty.[48] Scientists criticized nuclear powers for not committing themselves enough to disarmament, and urged the Italian government to take a clear stance in favor of the agreement. As we can read in the appeal, they considered the NPT as a useful step towards détente:

44 Roberto Gaja, *L'Italia nel mondo bipolare. Per una storia della politica estera italiana, 1943-1991* (Bologna: il Mulino, 1995), 173 ff.; Achille Albonetti, *L'Italia e l'atomica. Il governo, il parlamento, i partiti, i diplomatici, gli scienziati e la stampa* (Faenza: F.lli Lega, 1976); Albonetti, *L'atomica. L'Italia e l'Europa*, interview by Leopoldo Nuti (Roma: Albatros, 2014).

45 Francesco Calogero, Letter to Bernard T. Feld, February 28, 1967, AAm, box 503, folder 1.

46 Calogero, Letter to Feld, February 28, 1967, AAm, box 503, folder 1.

47 Albonetti, *L'atomica*, 41, 121-23; Albonetti, *L'Italia*, 171.

48 "Open Letter to Foreign Minister Mariano Rumor", September 26, 1974, AAm, SD, box 34, folder 2.

> The Non Proliferation Treaty has been a key element of international détente and it cleared the way for the first steps towards a global arms control agreement. The main responsibility is – of course – that of the two nuclear superpowers USA and USSR …. Throughout these years, just one country – India – has developed the technology needed for nuclear explosions, carrying out the underground test of May 18, 1974.[49]

Furthermore, highlighting the danger of fall-out that derived from nuclear explosions and the risk of a dual use of nuclear technologies, scientists warned the Italian government and public opinion of the ambiguous advantages that could come from any "pacific nuclear explosions". They considered the approaching first NPT Review Conference as a chance for Italy to have a voice in the international debate about nuclear proliferation and arms control, and therefore urged the government to complete accession to the treaty (through parliamentary ratification) before the conference, in order to fully participate in it. The 1974 letter ended with a petition to stop what appeared to be an "intentional attempt to delay as much as possible the Italian accession to the NPT", which was giving rise to speculations about an Italian latent nuclear ambition.[50]

Italy signed the NPT in 1969 but ratified it in 1975, after a six-year stalemate. In fact, although at first glance Italy had no other option than to sign the treaty, due to the strong alliance with Washington, archival documents show a stubborn opposition to the two superpowers' position on non-proliferation. It is possible, then, that the pressure of the scientific élite helped to some extent dispel the hindrances on the road to the Italian signature.

In the Italian context, Amaldi's struggle for nuclear disarmament was at times particularly complicated, given that he advocated the employment of atomic energy for peaceful uses.[51] He was persuaded that a middle country like Italy should launch a new industrial policy based on nuclear energy, which – in the long term – could reduce Italy's dependence on foreign energy sources.[52] This belief put Amaldi in a peculiar position, given that he was strongly opposed to any military use of nuclear energy, but championed – with a similar obstinacy – the opportunity to exploit nuclear energy for peaceful uses (therefore being often in contrast with that part of the anti-nuclear movement that was against *any possible use* of nuclear energy, both for military and for civilian purposes).

49 "Open Letter to Foreign Minister Mariano Rumor", September 26, 1974, AAm, SD, box 34, folder 2.

50 "Open Letter to Foreign Minister Mariano Rumor", September 26, 1974, AAm, SD, box 34, folder 2.

51 Rubbia and Angela, *Edoardo Amaldi*, 89-90, 274-78.

52 Amaldi, "Seminario di studio organizzato dal Comitato italiano per le ricerche sulla pace (CIRP) della SIOI", su "L'Italia e la prossima conferenza di Ginevra sul Trattato di non proliferazione nucleare", Roma, 16-17 April 1975, AAm, SE, box 55, folder "1975", 1-5; Calogero La Malfa and Ceccarini, *Contro la proliferazione*, 252-56.

During the 1970s and 1980s Amaldi found himself unable to extensively travel abroad. Nevertheless, his commitment to disarmament and peace remained strong. For instance, in 1981 wrote an appeal (signed by eight hundred and seventeen people) to the President of the Italian Republic Sandro Pertini concerning the Euromissiles crisis;[53] in 1983, he played an important role in the creation of the Unione Scienziati per il Disarmo (USPID) and in the establishment of the Sicurezza Internazionale e Controllo degli Armamenti (SICA) group in the Accademia dei Lincei (a working group shaped on the US Committee on International Security and Arms Control).

Conclusion

This chapter has analyzed the feeling of common responsibility clearly visible in the personal experience of a well-known Italian nuclear physicist, highlighting the interaction between scientific and political élites that occurred during the Cold War in the debate on security. I have argued that Amaldi's pragmatic approach, free from any national, ideological or class interests, was representative of a new perspective widespread in a part of the international community of scientists. Since the late 1950s, their ideas merged into the Pugwash movement, whose basic purpose was to safeguard humanity's common interest, namely peace. The "common awareness of a common danger"[54] was at the heart of nuclear physicists' efforts to participate in the arms control debate from the 1960s onwards, and urged them to promote a broad transnational dialogue about that issue, even during the most critical phases of the Cold War years.

Amaldi's story adds a relevant dimension to the debate that took place during the Cold War in Italy around nuclear issues, and enhances the understanding of Italy's policy concerning arms control and security. The heated debate regarding the country's accession to the NPT – in which scientists fiercely participated, supporting the ratification of the treaty – gives us a sense of the different perceptions existing in Italy around the nuclear proliferation issue. Although Italy – as a middle power firmly allied with the United States – probably had to sign the NPT in any case, in order to avoid an awkward dispute with Washington, nevertheless Italian politicians stubbornly resisted renouncing to a possible "nuclear option". As far as the NPT is concerned, archival sources point out that scientists had an important role in informing the Italian public about the dangers of the nuclear age, as well as in overcoming the most common reservations about the

53 "Appeal to the President of the Italian Republic Sandro Pertini", November 27, 1981, AAm, SE, box 61, folder 3; and "Comunicato Stampa", November 27, 1981, AAm, SE, box 10, folder 2.

54 Eugene Rabinowitch, "The Role of the Scientists in the Community", Paper for the Tenth Pugwash Conference on Science and World Affairs, AAm, SADF, box 263, folder 5, 6.

treaty. Thus, in the NPT case, scientists involved in disarmament issues achieved their two main goals: to make public opinion aware, and to press politicians.

Amaldi's ability to organize people around specific proposals, and his well-known position as professor at the University of Rome from 1937 to 1978 made him a "natural leader" of the Italian community of physicists. Furthermore, Amaldi's activities were pivotal in establishing an Italian network of scientists interested in peace and disarmament issues, who wanted to have a voice in Italy's nuclear policy. Thanks to Amaldi's example and his skill in organizing people, many other Italian scientists joined Pugwash and other parallel initiatives, such as the SICA conferences at the Accademia dei Lincei (then renamed the "Amaldi Conferences") and USPID. Their commitment shaped the following development of Pugwash and remains remarkable even today. It is in fact widely known that Pugwash was awarded the Nobel Peace Prize in 1995, when Francesco Calogero was Secretary General, and that the movement is currently led by another Italian, Paolo Cotta-Ramusino.

While it is difficult to assess to what extent Italian scientists' efforts in favor of détente and arms control succeeded in influencing Italian politics during the Cold War, their strong involvement in shaping their country's security policy is in itself a relevant issue for the history of the Italian nuclear experience. The polarized debate about the NPT highlighted – maybe for the first time with such intensity – the existence of an élite of civil society, normally not involved in foreign and security policies, claiming to have a voice in issues that were the government's prerogative, and this is a noteworthy matter in itself.

Carlo Patti

An Unusual Partnership: Brazilian-Italian Forms of Cooperation in the Nuclear Field (1951-1986)

Since the beginning of the nuclear age, Brazil has manifested a deep interest in mastering nuclear energy. Rich in atomic minerals – such as thorium and uranium – the Latin American country traditionally sought external cooperation to develop its own nuclear sector. Like other Third World countries, Brazil looked at the more advanced *North* to acquire knowledge, equipment and materials useful for its nuclear projects. As the main civilian nuclear power and traditional ally of Brazil, the United States was considered the natural partner to begin such an endeavor. However, during the long history of the Brazilian nuclear program, the limitations imposed by Washington to its external partnership pushed Brasilia to find the collaboration elsewhere. France, (West) Germany, and the United Kingdom are usually considered the other partners for Brazil's nuclear plans. The traditional literature on Brazil's nuclear history highlights, in fact, the association of Brazil with West Germany in the 1950s and, above all, in the 1970s, when a major deal was signed to transfer the whole nuclear fuel cycle.[1] Similarly, France played a central role in Brazil's nuclear plans. As is known, hundreds of Brazilian nuclear scientists and technicians were trained in both France and West Germany, and crucial technologies, knowledge and machineries were acquired in those countries. This occurred when Washington was not available to cooperate. Over the last sixty years, however, Brazil has also sought collaboration with other countries of the so-called *North*, such as the Netherlands, Norway, Sweden, and Italy. The Italian case appears particularly important. While the Brazilian authorities collaborated sporadically with the other European countries, the history of Brazil's nuclear program can be interpreted as a constant attempt at collaboration with Italy from the early efforts to set up a nuclear program in Rio de Janeiro, until the end of the Italian nuclear program in the late 1980s.

This chapter aims to shed light on a little-known story of cooperation between Brazil, a developing country, and Italy, that became one of the major industrialized countries

1 Guilherme Camargo, *O fogo dos deuses. Uma história da energia nuclear* (Rio de Janeiro: Contraponto, 2006).

during the period analyzed in this study. Until now the Brazilian-Italian cooperation has not been the object of a detailed study, and little mention has been made in general works on the history of nuclear energy in Brazil. The object of this study is to explore the history of the cooperation, or attempts at cooperation, between Brazil and Italy in the period 1951-1986. Three specific episodes will be analyzed: the contacts between Italian and Brazilian scientists in the early 1950s; the attempt to acquire knowledge over a sensitive dual-use technology, such as uranium enrichment, in the late 1960s-early 1970s; and finally, the Brazilian-Italian talks about a possible sale of low enriched uranium to Brazil from the Italian share in the European consortium EURODIF, and the cooperation on fast breeder reactors. The three episodes will correspond to different phases of the evolution of the Brazilian nuclear program: the initial attempt to establish a program in the early 1950s; the planning of a new civilian nuclear program in the early 1970s, and specifically the choice of the best method for the uranium isotopic separation; and a more mature phase of implementation of the Brazilian nuclear plans, in the late 1970s-early 1980s. This study will also highlight the participation of Italian scientists in the planning of the Brazilian nuclear program. This research relies on primary sources from Brazilian archives, oral history interviews, and on a limited existing literature on the topic.

The Origins of the Brazilian Nuclear Program and the Cooperation with Italy

Immediately after receiving the news of the bombings in Hiroshima and Nagasaki, Brazilian scientists, politicians, and the military began a long debate over the possible use of nuclear energy in the country, both for peaceful and military ends.[2] As a provider of nuclear minerals for the Manhattan Project in 1945, Brazil was thought to own one of the largest reserves of thorium, and American geological surveys indicated a rich presence of uranium in Brazilian soil. Aware of this abundance, the Brazilian government finally decided in 1951 to begin a nuclear program through the creation of a national research council, the Conselho Nacional de Pesquisa (CNPq). The establishment of a nuclear project and the centralization of the Brazilian research activities followed, consequently, a common path. Brazil, at that time a small power with an economy depending mainly on the export of coffee, was passing through a slow process of industrialization.

2 *Ofício de Orlando Rangel à Diretoria do Material Bélico do Exército Brasileiro*, August 8, 1945, Arquivo Álvaro Alberto, Centro Interunidade de História da Ciência, Universidade de São Paulo, São Paulo, Brasil (hereafter AA/USP). In March 1946, after several months of internal debate, the Brazilian Congress created a commission for discussing the establishment of a national nuclear program. The first results of the discussions were submitted to the Brazilian National Security Council in the early 1947.

With the democratic election of Getulio Vargas as President of Brazil in 1950, who had been the country's authoritarian ruler between 1930 and 1945, the transformation of Brazil from a rural to an industrial economy became one of government's main priorities. Since the first speech of Vargas to the Brazilian Congress, the peaceful use of nuclear energy was considered crucial for the future development of the country. While Brazil was rich in mineral resources, the country lacked an advanced research sector, technologies, and industrial equipment. However, as the prominent Brazilian nuclear scientists José Israel Vargas noted in a recent interview, Brazil had a young generation of brilliant scientists, such as the Italian-descendent Cesare (César) Mansueto Lattes and José Leite Lopes.[3] Lattes had discovered in 1945 the *meson-pi* during his stay in the United States, a fact that turned the young Brazilian researcher into a recognized scientist at international level. The Brazilian effort to explore nuclear energy relied, consequently, on a young group of scientists who had studied a few years before at the University of São Paulo, under the direction of two Italian *émigrés*: Giuseppe Occhialini and Gleb Wataghin. The two scientists, in fact, had left Italy during Fascism and found refuge in Brazil, where they contributed to the foundation of the Department of Physics in the Faculty of Philosophy at the University of São Paulo. It was the first serious effort to create a scientific sector in Brazil. While that moment marked the Brazilian history of science, the second one can be found in the aforementioned effort to create a research council that had the main purpose of developing nuclear energy. The protagonist of this endeavor was Rear-Admiral Álvaro Alberto da Motta e Silva, chosen as the first chairman of the Brazilian National Research Council. He had been previously the President of the Academia Brasileira de Ciência (ABC), but, above all, the Brazilian representative within the United Nations Atomic Energy Commission (UNAEC). It was thanks to this experience that he became the main promoter of nuclear energy in Brazil and a member of an international network of nuclear scientists. His plan, approved by the Brazilian President in November 1953, was to master the atoms in an autonomous way. The Brazilian nuclear project involved the full control of the national mineral atomic resources and the implantation of a nuclear sector thanks to the cooperation with foreign countries. Alberto's effort was not the first step toward deeper studies in the nuclear field. Indeed, a few years earlier the Centro Brasileiro de Pesquisas Físicas (CBPF) had been founded in Rio de Janeiro under the supervision of the aforementioned Cesar Lattes.

The quest for external collaboration was not an easy task. As is known, the period was not propitious for acquiring knowledge and technologies abroad. The United States, the most advanced country in the nuclear field at that time, substantially banned partnership with other countries, even with suppliers of nuclear minerals, such as Brazil. Even

3 Carlo Patti, *O programa nuclear brasileiro: uma história oral* (Rio de Janeiro: FGV, 2014), 110.

though in 1951 the United States amended the national legislation on nuclear energy allowing a limited cooperation in the academic field, Brazil could not rely on collaboration with Washington. Thanks to an agreement signed in 1952, the Latin American country was only able to train nuclear scientists in the United States and to acquire a small synchrocyclotron. The Brazilian National Research Council, under the leadership of Alberto and the full support of President Vargas, elaborated a strategy to look for other partners in Western Europe. Álberto and his closest collaborators visited the main research centers in Norway, France, West Germany, United Kingdom, Switzerland, the Netherlands, and Italy. Thanks to agreements with the French and West German institutions, the Brazilian government attempted to acquire facilities for refining and enriching uranium. Many Brazilian scientists were also to study in Saclay (France), Bonn and Göttingen research centers.

Italy played a relevant role in the first phase of the Brazilian nuclear project. The country was considered a model for Brazil both for the structure of its research council, and above all for the similarities between the two nuclear programs. Brazil, like Italy, wanted to exploit its national nuclear minerals and aimed at acquiring the necessary knowledge and equipment. For this reason, after a visit to Italy, Alberto and one of his closest collaborators, Luiz Cintra do Prado, underlined the need to cooperate with Italian research centers and nuclear energy organizations. Between July and August 1953, Cintra do Prado spent several weeks in Italy. The Brazilians recognized the high level of physics centers in Rome, Milan, and Turin, where the former professor of the University of São Paulo, Wataghin, was one of the leaders of the Italian Istituto Nazionale di Fisica Nucleare (INFN). The "magnificent centers", as Cintra do Prado wrote in his reports to Brazil, were a reference for their empirical and theoretical research on pure nuclear physics. However, it was in the organization of the nuclear field that the Brazilian scientist exalted the Italian progress. The Centro Informazioni Studi ed Esperienze (CISE), a private-public initiative in Milan, was considered the "Italian Organization for Atomic Energy". In a few years, noted Cintra do Prado, the CISE had advanced rapidly in fundamental research. Moreover, it owned a facility for producing heavy water on a semi-industrial scale and metallic uranium. Finally, the organization had acquired all the elements for designing a research reactor (fueled by natural uranium). The CNPq counselor concluded his report with enthusiastic words for the CISE: "CISE constitutes a very useful example for Brazil being a certification that, in applied science, a perseverant work can lead to significant practical results, even if material resources are scarce and in apparent disproportion with the stated goals".[4]

4 *Relatório geral das observações colhidas pelo Conselheiro Cintra do Prado na Itália, França, Espanha e Grã-Bretanha*, n.d., AA/USP, QO45003.

Italy, and particularly the CISE, was considered a model to follow by the incipient Brazilian program. The two countries were, in fact, following parallel paths in the nuclear energy field. If one compares the aims of Italian activities in the late 1940s and early 1950s, it is possible to find a parallel between the Italian and the Brazilian experience. In a context of limited cooperation offered by the United States, the main partner of the two countries, Italy and Brazil attempted to rely on other partners and reach significant results in an autonomous way. Like Italy, Brazil aimed at acquiring the capabilities for setting up a nuclear program and exploiting national resources with the clear goal of researching and building power reactors.

It is also for this reason that in early August 1953, Italian and Brazilian authorities signed a cooperation agreement to exchange researchers. Following the model of the Italian-French cooperation, that allowed to avoid costs in foreign currency, Alberto and Professor Gustavo Colonnetti, the chairman of the Italian Consiglio Nazionale delle Ricerche (CNR) agreed to begin a fruitful collaboration between Italian and Brazilian nuclear scientists.[5] It was a clear continuation of the strong Italian presence in the creation of a scientific sector in Brazil. Another important step was the signing of a memorandum of understanding between the Istituto Nazionale di Fisica Nucleare (INFN) of Turin and the CNPq. It allowed a Brazilian scientist, such as Cesar Lattes, to work again with his mentor, Wataghin.[6]

Even if the two countries aimed at beginning a fruitful collaboration, a deep change in the international and Brazilian domestic context impeded the start of a strategic partnership. Internationally, the Atoms for Peace program together with the reform of the US Atomic Energy Act, led both Brazil and Italy to establish a deeper cooperation with Washington. Domestically, a political crisis that led to the end of Vargas' nationalist rule brought about a reorientation of the atomic program. Because of US and domestic pressures Alberto resigned and the nuclear program was reformulated to work together with the United States, abandoning or downscaling the partnership with European countries. Brazil, in fact, deeply modified the guidelines of the program, and in 1958 acquired a research reactor in the Atoms for Peace context. Despite a reorganization of the nuclear sector, and the creation of the Brazilian Comissão Nacional de Energia Nu-

5 *Convênio com a Itália para a permuta de cientistas e pesquisadores*, Álvaro Alberto to Vicente Ráo (Brazilian minister of Foreign Affairs), Ofício 1989. 524. 26 (96). September 29, 1953, Arquivo Histórico do Ministério das Relações Exteriores, Brasília, Brasil (hereafter AHMRE), folder 563.80 Energia Atômica ou Nuclear, tomo 1, 1951-1953 (hereafter tomo 1).

6 *Brazilian Embassy in Rome to Álvaro Alberto*, Secret, August 3, 1953, AAl, Q088007; *Parafrase da comunicação feita ao Itamaraty*, July 28, 1953, AAl, Q088015; Alberto met with both Colonnetti and Wataghin on July 27, 1953, *Missão do Almirante Álvaro Alberto à Itália*, Brazilian Embassy in Rome to the Brazilian Foreign Ministry, De/DPo/524.26, Secret, July 28, 1953, AHMRE, tomo 1.

clear (CNEN), the Brazilian program was downscaled. Even if between 1956 and 1968 there existed a vague project to acquire nuclear power plants, Brazil limited its activities to research.[7] In its relations with Italy, it continued to cooperate in the academic field, but on a very limited scale. During this period, however, prominent Brazilian nuclear physicists spent long periods in Italy to work in research centers in Rome and Naples. This was the case of Hervásio de Carvalho, counselor of the CNPq and future chairman of the CNEN, who had been highly appreciated by his colleagues in Italy.[8] It was only in the late 1960s and early 1970s that Italian and Brazilian authorities began to discuss possible forms of cooperation between the two countries in a crucial area such as uranium enrichment.

Italy and the Brazilian Quest for Uranium Enrichment Technologies

After more than ten years of substantial stasis, the Brazilian government adopted a new nuclear policy. Marshal Arthur da Costa e Silva, second President of the Brazilian military regime, authorized, together with the Brazilian National Security Council, the elaboration of a new nuclear plan. As a result of the strong economic growth – between 1968 and 1974 the Brazilian economy boomed up to 12 per cent per year – Brasilia decided that in order to support its industrialization it was necessary to integrate nuclear energy in the Brazilian energy matrix, dominated by hydropower. A possible drought, in fact, could heavily affect the Brazilian production of electric power. Energy, but also military ambitions, led the government of Costa e Silva to an elaborated and detailed Brazilian nuclear project. The final aim was to build an unspecified number of nuclear power plants, master the entire nuclear fuel cycle by exploiting the national reserves of uranium, and acquire the capability to build a peaceful nuclear device. The purpose, not differently from 1953, was to reach autonomy in the nuclear field. The plan, submitted

7 However, it should be noted that the Italian company AGIP Nucleare participated in the international bid in early 1962 for the construction of the first nuclear power plant in Brazil. A Brazilian commission selected a French company, but financial reasons impeded implementing the project. *Companies qualified to Bid on Brazil's South Central Nuclear Power Plant*, US Embassy in Rio de Janeiro to Washington, Air Pouch, Unclassified, January 23, 1962, 2, National Archives and Records Administration, Washington, DC, United States (hereafter NARA), Aid and Assistance Programs, 1, Equipment Grants Brazil, 1959-62, S/AE.

8 Carvalho, considered one of the protagonists of the Brazilian nuclear program between the 1950s and the 1980s, spent almost two years in Italy in Naples and at the national center of nuclear research in La Casaccia (Rome). On Carvalho's stay in Italy see the letter sent by Edoardo Amaldi to Marcelo Damy de Souza Santos (chairman of the CNEN) on February 15, 1965. The letter is present in Amaldi's personal archives at the Università "La Sapienza" in Rome. I would like to thank Professor Giovanni Battimelli for having kindly provided a copy of these documents.

and approved in 1968, determined the acquisition of power reactors and of nuclear fuel from external partners as a first step in the endeavor. A few years later, in 1972, Brazil signed a contract with the US company Westinghouse and the US Atomic Energy Commission (USAEC) to acquire a nuclear power plant and the fuel supply, with the option for a second power reactor.

The first oil crisis, in autumn 1973, led Brazil to accelerate its nuclear plans. The Second National Development Plan of 1974, along with the energy plan Plano 90, determined the acquisition of up to nine nuclear power plants to be built until 1990. Nuclear energy should integrate hydroelectric power and compensate the loss of thermoelectric energy produced by oil power plants. Relying for more than 80 per cent on external supplies of oil, Brazil, like other countries, chose nuclear energy as a possible alternative. The atomic plan elaborated in 1973 was ambitious: acquiring nuclear power plants, the capability to build nuclear reactors, and mastering all the phases of the nuclear fuel cycle. The Companhia Brasileira de Tecnologia Nuclear (CBTN) was established in 1972 with the specific purpose of stimulating the creation of a national nuclear industry and elaborating the most appropriate nuclear strategy for the country. With an activity substantially reduced to academic research in São Paulo, Belo Horizonte and Rio de Janeiro, the CBTN presented a detailed plan to collaborate with external partners. One of the main purposes was to acquire the knowledge and the capability to master a crucial technology to produce nuclear fuel: uranium enrichment. As noted earlier, Brazil had already attempted in the mid-1950s to obtain a new method for uranium isotopic separation: ultracentrifugation. In 1958 the Brazilian Nuclear Energy Commission received three ultracentrifuges from West Germany and a few scientists were trained in how to use them. However, with the end of the first phase of the Brazilian nuclear program, in 1955, the Brazilian nuclear authorities decided to opt for natural uranium reactors, discarding the option for enriched uranium. The West German ultracentrifuges had been, consequently, partially abandoned at the Instituto de Pesquisa Química (IPQ) of the University of São Paulo. During the period 1958-1966, however, a small research group, led by Professor Ivo Jordan, used the equipment to reach the first isotopic separation in 1966.[9] Despite this important outcome, the University suspended the research effort and in 1968 the Brazilian government declined an important West German offer to collaborate on a most advanced ultracentrifuge isotopic uranium separation method. Thanks to the decision to acquire nuclear power plants fueled by low enriched uranium, Brazil gave increased attention to all the possible methods for enriching uranium, such as gaseous diffusion, the jet nozzle. Starting from 1972, though, it gave preference to

9 Odete Maria Oliveria, *Os descaminhos do Brasil nuclear* (Unijuí: Ijuí, 1998), 240.

ultracentrifugation.[10] As is clear from recently declassified documents, the Brazilian nuclear strategy, elaborated in 1973, considered Italy, among other countries, a possible partner to acquire such capabilities.[11]

The Brazilians were aware of the Italian effort to master the uranium enrichment technology and had known about their interest in the ultracentrifuges since the late 1950s.[12] For this reason in 1971, Brazil and Italy signed an agreement of cooperation in the nuclear field.[13] One of the main aims of the deal consisted in the visit of Brazilian scientists to Italian uranium enrichment facilities. The above-mentioned Jordan was one of the first to be sent to Italy. In this case, however, the exchange of information was bidirectional. The Italians, in fact, were interested in Jordan's studies of the ultracentrifuge method for isotopic separation and obtained a copy of his Master's thesis on the topic. Between 1973 and 1975, when Brazil decided to acquire uranium enrichment technology from West Germany and to train its nuclear scientists in the Jülich research center, several Brazilian scientists were sent to Italy to be trained in the field. Both Brazil and Italy were particularly interested in the ultracentrifuge method, and considered it the most efficient in the field of uranium isotopic separation.[14] Brazilians considered Italians particularly advanced in that sector, and a Nuclebrás internal document remarked that Italy had mastered such technology on a semi-industrial scale.[15] As is clear from the available documentation, in 1972 the Casaccia research center received four Brazilian technicians who spent a semester in Italy.[16]

From the perspective of the CBTN the collaboration was fruitful. Several documents describe the Italian-Brazilian relationship as a possible strategic partnership for the future of the Brazilian nuclear program. The personnel trained in Italy, in fact, represented

10 *Estágio de desenvolvimento do processo de enriquecimento por jato centrífugo de gás (nozzle jet) em junho de 1974*, CNEN internal document, n.d., Arquivo Paulo Nogueira Batista, Centro de Pesquisa e Documentação sobre a História Contemporânea do Brasil, Fundação Getulio Vargas, Rio de Janeiro, Brazil (hereafter APNB), pn c 1969.12.01, 136/3528.

11 *Programa Nuclear Brasileiro*, October 1974, CBTN internal document. Document kindly provided by Professor Maurício Grinberg.

12 Álvaro Alberto to Wilhelm Groth, December 12, 1957, AA/USP, Q071047.

13 *Enriquecimento de urânio*, CNEN internal document, n.d., APNB, pn c 1976.04.29, 288/315.

14 *Tecnologia de Enriquecimento de Urânio in Estágio de desenvolvimento do processo de enriquecimento por jato centrífugo de gás (nozzle jet) em junho de 1974*, CNEN internal document, APNB, pn c 1969.12.01, 139/3528.

15 Nuclebrás internal document, n.d., APNB, pn c 1969.12.01, 2286/3528. The same document also highlighted the Italian effort in the laser in the laboratory scale.

16 Four Brazilian scientists were trained in Italy. They were: Duilio Russo, an electronic engineer, who worked for NUCLEI; José Wellington Dias Lemos, an industrial chemist, who worked for NUSTEP; Dante Leonardo Zoratto, a mechanical engineer, who worked for Nuclebrás; and Raad Yahya Qassim, a chemical engineer, who worked for Nuclebrás. *Pessoal da Nuclebrás treinado na área de enriquecimento*, Nuclebrás internal document, n.d, APNB, pn c 1969.12.01, 435/3528.

the core of the future group of scientists and technicians that constituted the Brazilian Nuclebrás Enriquecimento Isotópico (NUCLEI), a public company established in 1975 to produce nuclear fuel. Even if Brazil obtained the knowledge and the technologies of the jet nozzle separation method from West Germany, the cooperation with Italy appeared crucial. Starting from 1981, the NUCLEI worked with the Italian company Nuovo Pignone in the construction of special compressors needed for uranium isotopic separation through the jet nozzle.[17]

New Attempts in Cooperation with Brazil: Fast Breeder Reactors and Nuclear Fuel

The cooperation with Italy was not limited to uranium enrichment, but also comprised fast breeder reactors, especially in the late 1970s and the early 1980s. Since the end of the 1960s, a group of Brazilian scientists at the Federal University of Minas Gerais in Belo Horizonte had started studying fast breeder reactors. The Brazilian nuclear sector, in fact, was interested in acquiring technologies and knowledge for the next generation of reactors. The strategic partner in this case was not West Germany, but France and, later, Italy. Starting from 1974, Brazil began a strong cooperation with France, to construct the Cooperação Brasil (COBRA) reactor. However, since France could not supply the plutonium needed to fuel the reactor, the two countries ended their collaboration. In order to continue research in that field, the Brazilian Nuclear Energy Commission signed a new cooperation agreement with the Italian Nuclear Energy Commission in 1981. As the then President of Nuclebrás, Paulo Nogueira Batista, declared, Italy represented the best substitute for France. Even if some Brazilians opposed the cooperation with the Italians, because of a supposed Italian lack of expertise, Nogueira Batista highlighted that Italy was playing a crucial role in the construction of the Superphénix reactor in France, by supplying parts for the tests and systems developed for the reactor. For this reason, Brazil could acquire important skills thanks to the cooperation with Rome, even if it could not receive plutonium.[18] The deal consisted in training Brazilian personnel in Italy and establishing standards for the thermo-hydraulic circuit of metallic sodium. The Brazilian program was incipient, but the collaboration with Italy appeared at that time essential.[19] Stefano Moretti, an Italian nuclear scientist and former advisor of the Italian

17 *Minuta de reunião*, Nuovo Pignone, Florença (Itália), September 25, 1981, APNB, pn c 1969.12.01, 2525/3528.

18 *Entrevista "O Estado de São Paulo"*, November 9, 1981, APNB, pn n 1975.11.11, 601/1877.

19 *Tecnologias avançadas in Relatório Final da Comissão de Avaliação do Programa Nuclear Brasileiro* (CAPNB), August 6, 1986, APNB, pn na 1975.11.11, 1087/1877.

CNEN secretary-general, left Italy to work in the Brazilian group. As he recalled in a recent interview, he joined the Brazilian nuclear program and worked for a few years in Belo Horizonte, on the fast breeder reactor project.[20] Brazilians and Italians collaborated in that field until the conclusion of the Italian nuclear program in 1987.

Another important episode of Italian-Brazilian relations concerns the Brazilian presence in the market of nuclear fuel. With a project to build up to eight nuclear power plants until 1990, Brazil attracted the suppliers of low enriched uranium, including Italy, an associate to the European consortium EURODIF for uranium enrichment. As reported by a secret Brazilian diplomatic record in 1978, Colombo, chairman of the Italian National Committee of Nuclear Energy offered Hervásio de Carvalho, his Brazilian counterpart, to transfer part of the enrichment services owned by the Italian company AGIP Nucleare in EURODIF.[21] The downscale of the Italian nuclear program in the late 1970s, with a substantial reduction in the power plants to be built, allowed Italy to sell 120,000 uts/a to Brazil. In 1978, the Brazilian government did not take a clear position on the issue, but Italy renewed the offer in 1980, on the occasion of the International Atomic Energy Agency (IAEA) General Conference in New Delhi, for a lower amount of enriched uranium and a more convenient price. However, Nuclebrás, declined the Italian offer. Thanks to the existing contracts with the Uranium Enrichment Consortium (URENCO), the US Department of Energy, and the future Brazilian capability to produce nuclear fuel, the Brazilians estimated that they did not need to contract new enrichment services until 1990.[22] Brazilian estimates were to be reduced in the near future, since the deep economic crisis that affected Brazil from 1982 onwards led to a substantial cut in the number of reactors to be built.

Conclusion

This chapter has highlighted unexplored aspects of the history of Brazil's nuclear program: the cooperation with Italy. During the three periods considered in this study, Brazilian authorities considered Italy an important partner for the development of their national nuclear program. Many parallels exist between the Brazilian and the Italian efforts at the beginning of the nuclear age. Italy, particularly CISE, represented a model for Brazil to structure its own nuclear program. Moreover, Brazilians considered the quest of autonomy in the nuclear field a shared goal with the Italian institution. As we

20 Stefano Moretti, interview with the author, July 28, 2014, Rio de Janeiro.

21 *Energia nuclear. Itália-Brasil. Enriquecimento de urânio*, 20 de janeiro de 1980, Secreto, DEM/DE-I/01/644.2, B46, F31, APNB, pn a 1973.05.18, 23/50.

22 Nuclebrás internal document, APNB, pn a 1973.05.18, 25/50.

have seen, the cooperation between the two countries was limited to the academic field, but it began a long tradition of exchange. In the following phase, in the early 1970s, Italy and Brazil attempted to collaborate in the study of uranium enrichment. Thanks to an agreement signed in 1971, Brazilian scientists spent periods in Italian research centers. As appears from the Brazilian nuclear strategy elaborated in 1973, Italy was considered one of the possible strategic partners for the future ambitious nuclear program that aimed at acquiring nuclear power plants and mastering the nuclear fuel cycle. The attempt in cooperation was frozen in 1975, after the signing of a major deal between Brazil and West Germany, which led the Latin American country to opt for a West German method for uranium isotopic separation: the jet nozzle. At the end of the 1970s, in a more mature phase of the Brazilian nuclear program and with a more consolidated nuclear sector, the two countries started new talks. Brazil was seen by Italy as a buyer of low enriched uranium, at a time when the latter revised its future consumption of nuclear fuel. The last important field of cooperation between Rome and Brasilia was an agreement on fast breeder reactors. Brazilian institutions were, in fact, active in researching the future generation of power reactors and Italy represented a strategic partner until the end of the Italian nuclear program in 1987.

Future research should focus on the Italian documentation and explore new topics of analysis. It would be particularly interesting to understand whether Brazil and Italy discussed the possible transfer of nuclear minerals to the European country, as France and West Germany did, during the 1950s. Moreover, it would be useful to understand if Italian authorities and scientists collaborated with Brazil in the so-called civilian-military parallel nuclear program, which began in 1979 and ended in 1990 with important achievements for Brazil, such as mastering uranium hexafluoride production and ultracentrifuge uranium enrichment technology. Given the interest of the Brazilian Navy in the ultracentrifuge enrichment method starting from the mid-1970s, it would be possible for the Brazilian and Italian individuals to continue to collaborate in the area, as happened with the West German experts. Some documents of the early 1980s, show that on the occasion of the limitation of the cooperation with the United States, the Brazilian authorities recommended strengthening the collaboration in the nuclear area with Italy, which they considered to be one of the most advanced countries in the field.[23]

23 *Relações Brasil – Estados Unidos do campo da energia nuclear*, CNEN internal document, 1980, APNB, pn n 1976.04.14.

Giorgio Ferrari Ruffino

A Particular Experience: How a Nuclear Expert Became an Antinuke

Much of the consolidated knowledge now applied in the design and fabrication of nuclear fuel was obtained between the mid-1960s and the mid-1970s, with the contribution of relevant institutions and public companies, through research programs aimed at studying the nuclear, mechanical and thermal-hydraulic behavior of nuclear fuel in the core.[1]

The first agreement for international cooperation between Europe and the United States in the development of Nuclear Power Plants (NPP) was signed on May 29, 1958 in Brussels when the US government and Euratom agreed on a memorandum of understanding to develop a Joint Nuclear Power Program. The main aim of this program was to build, in the six Euratom countries, nuclear power plants totaling 1,000 MWe of proven light water reactor technology, a technology in which the United States was at the forefront. The total cost of the program was estimated at 350 million dollars, of which the American government was ready to provide Euratom with 135 million. Special arrangements concerned the fuel cycle, including the burden of reprocessing irradiated fuel, which the US government declared itself willing to do in the United States. The American government and Euratom also intended to promote a joint program of research and development to be carried out both in the United States and in Europe on the types of reactors to be built, focusing especially on nuclear fuel. To this end, both parties agreed to allocate 50 million dollars for the first five years.

However, although the US government wished to export light-water reactor technology to Europe, the Joint Nuclear Power Program was scarcely implemented. At that time, no light-water reactor had been put into operation (in the United States the first NPPs Dresden and Yankee Rowe became critical in 1959 and in 1960 respectively), while France and England were engaged in the development of gas-graphite reactors.

1 In those years, there was a US Atomic Energy Commission-Euratom operational cooperation agreement, and many public companies, such as British Nuclear Fuels Ltf (BNFL), Electricité de France (EDF), and the Ente Nazionale per l'Energia Elettrica (ENEL), participated in these activities.

Only Italy and Germany chose to build light-water reactors of the first generation, in Garigliano (a boiling water reactor - BWR), in Trino Vercellese (a pressurized water reactor - PWR) and in Gundremmingen (a BWR), which entered into operation respectively in 1964, 1965 and 1966.

It should be noted that in those years nuclear technology was in its "pioneering" stage, and the development of NPPs proceeded slowly. This meant that changes were often introduced in the engineering aspects and the data management, in order to improve the performance and reliability of the systems. The exchange of knowledge between European and American nuclear utilities was thus an important factor in the improvement of nuclear technology. However, there were significant differences in the approach to the design, construction, operation and safety of nuclear installations, which made it difficult to compare the different experiences. As a result, it became necessary to adopt a comprehensive approach to these problems, in order to provide a common reference for evaluating the reliability of the plants, which depends on a set of complex interdisciplinary processes that must be kept under control during all the steps involved in the building of a NPP.

The answer to these needs was the development of Quality Assurance, a system of rules and principles that was not limited to the control and testing of the final product, but allowed to intervene at every stage of the process, from the design to the operational phase, for each system and component involved in the NPP.

The United States was the first country to define a quality system in the nuclear sector based on a shared set of criteria and rules, with the publication by the Atomic Energy Commission (AEC) of Federal Code 10 CFR 50 Appendix B (*Quality Assurance Criteria for Nuclear Power Plants*), issued in 1970.

This document establishes eighteen basic requirements for the design, construction, manufacture and operation of structures, systems and components related to the safety of NPPs. In order to standardize the activities of nuclear facilities in the implementation of 10 CFR 50 App B, several other documents were developed such as ASME NQA-1 (*Quality Assurance Requirements for Nuclear Facility Applications*) and the series ANSI N 45.2 (*Quality Assurance Program Requirements for Nuclear Facilities*). The Nuclear Regulatory Commission (NRC), which replaced the AEC, approved both documents. In the wake of the publication of 10 CFR 50 App B and following the target of standardization, several other standards were developed throughout the world, such as the German standards by the Deutsches Institut für Normung (DIN) and the Italians by the Ente Nazionale Italiano di Unificazione (UNI).

The Italian company Ente Nazionale per l'Energia Elettrica (ENEL) was among the first to adopt 10 CFR 50 App B and from the early 1970s began to develop its own quality system. This involved a strong commitment on the part of many technicians, given that the eighteen basic requirements of 10 CFR 50 App B described "what" needed to be done, but not "how" to do it. In other words, in order to apply the principles of the Code, it was necessary to develop a set of procedures, technical specifications and standards needed to achieve the quality objectives, especially given that at the time ENEL was evaluating the project of the Caorso NPP.

In those years, I had completed my training on the job, working in nuclear plants and participating in the review of some projects of NPP systems. Therefore, I welcomed with enthusiasm the idea of specializing in the design and fabrication control of nuclear fuel. I served in this activity until 1987 when, after the Chernobyl disaster, I decided to make a moral objection.

Nuclear Fuel: A Special Component

Nuclear fuel is a key component of the NPP operation. Being made of fissile material, mainly uranium, it represents the source of energy without which it would be impossible to operate the NPP. At the same time, nuclear fuel is of particular importance in terms of safety, since it makes up the first containment of fission products that are retained inside by the fuel cladding. Therefore, nuclear fuel performance and reliability are of utmost importance for the safe operation of NPPs, and it is crucial to maintain fuel integrity in all operating conditions.

Fuel integrity and performance mainly depend on:

1) Design criteria and specifications.
   Nuclear fuel is designed to ensure that possible fuel damage does not result in the release of radioactive materials in excess of the limits prescribed by the Safety Authority. Evaluations are made in conjunction with the core nuclear characteristics, the core hydraulic characteristics and the plant equipment characteristics. These general criteria must be correctly translated into specifications, drawings and procedures.
2) Fabrication methods and procedures.
   All phases of the manufacturing process must be supported by documented instructions, procedures or drawings that have to include specific quantitative or qualitative acceptance criteria for each material, component, test and process to be carried out during manufacturing.
3) Operation procedures.
   Operating limits are established to ensure that the actual fuel operation is maintained within the fuel rod thermal-mechanical design bases. These operating limits define the maximum allowable fuel pellet operating power level as a function of fuel pellet exposure.

Nevertheless, since a limited number of fuel failures do take place, it is important to investigate the mechanisms of rupture that occur during operations, in order to improve manufacturing techniques and forms of control or, if necessary, change the design specifications.

From this point of view, another important tool used to improve nuclear fuel performance and reliability was the Post Irradiation Examination (PIE), a survey method widely adopted in the 1960s and 1970s, but abandoned since the 1990s because of its high costs. The techniques currently in use for the control of nuclear fuel failure are based on sipping tests. This method investigates the fission product release in a fixed volume of a circulating reactor cooling water and is commonly used as a way to monitor the integrity of spent fuel elements in wet storage, or to investigate fuel elements that are suspected to have failed during the course of operation. However, since sipping tests do not provide indications on the remote causes that led to the fuel failure, there is a significant uncertainty on fuel failure mechanism evaluation. According to International Atomic Energy Agency (IAEA) estimates, today ~ 25% of fuel failure causes in light-water reactors are unknown.

Nuclear Fuel Fabrication and PIE

From the point of view of manufacture, nuclear fuel presents a series of very special characteristics that are often underestimated. Unlike other key components, nuclear fuel is produced in large quantities but must comply with very strict criteria that other components do not require. Ultimately, nuclear fuel fabrication may be regarded as a *mass production with extremely high quality standards.* This large-scale production – millions of Fuel Rods (FR), thousands of Fuel Assemblies (FA) – requires an extremely rigorous and reliable control system, along with a set of consolidated manufacturing procedures. Controls and procedures are integrated in a quality system, which operates at all stages of manufacturing. In the industrial field, nuclear fuel design and fabrication represent the most complex implementation of Quality Assurance criteria definitions:

> … "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a system, structure or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provides a means to control the quality of the material, structure component or system to predetermined requirements.[2]

2 United States Nuclear Regulatory Commission, *NRC Regulations*, Title 10, "Code of Federal Regulations", Appendix B to Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Reprocessing

A good quality system must meet the following criteria:
– full compliance with design and engineering specifications,
– reliability on fabrication methods and procedures,
– complete traceability of processes,
– very high precision working (to comply with strict tolerances),
– accuracy in cleaning and handling,
– highly skilled operators,
– quality control effectiveness.

Normally, an entire core of a 1,000 MWe NPP consists of 157 FA (the PWR type) or 624 FA (the BWR type). This means that the total number of controls required during the first core nuclear fuel fabrication varies from 14,256,000 (BWR) to 15,205,000 (PWR). A detail of these typical controls is shown in Figure 1.

Major components	Number of controls per component	Assembly cumulative controls (BWR) (8x8-2)	Assembly cumulative controls (PWR) (17x17-25)	Core total controls** (BWR) (624 FA) (38,688 FR)	Core total controls** (PWR) (157 FA) (41,448 FR)
UO2 pellets	17x20***				
Zr tubes	10	↓	↓		
End cups	4	> 21,948	> 93,456		
Fuel rods	13				
Spacer grids	6			↓	↓
Nozzles	3	↓	↓		
Fuel assemblies	13	~ 900	~ 3,400	14,256,000	15,205,000

Figure 1. Nuclear fuel fabrication control amplitude*.

* Excluding controls on row materials performed by suppliers (UO2 powders; metal ingots, etc.).
** 1000 MWe.
*** 20 pellets per rod tested.

Facilities", http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html, last accessed November 13, 2016.

Post Irradiation Examination

The severe operating conditions of reactors cause many stresses to the nuclear fuel. The high temperatures reached with fission modify the structure of the uranium pellets that interact with the cladding and deform it. At the same time, the cladding is subjected to mechanical stresses and stress-corrosion caused by cooling water. The combination of these factors, especially during transient reactor power, can cause the failure of nuclear fuel and the release of fission products.

PIE helps determine the causes of these failures and provides information on the performance of the fuel in the core, such as:

1) correlations for the prediction of reactivity coefficients under various operating conditions,
2) evaluation of reactivity variation due to a pH variation in the primary coolant,
3) analysis of power density distributions,
4) analysis of the core flow redistribution.

PIEs are of two types: destructive and non-destructive. One of the main techniques for non-destructive testing involves exposing the irradiated fuel to γ- scanning (gamma-scanning) in order to determine the axial distribution of the radioactive fission products, and consequently of the burnup.[3] The gamma-scanning method measures gamma activities of certain fission products that are proportional to the burnup. Problems associated with this method are migration of the fission products and gamma-ray attenuation through the relatively dense fuel material.

Destructive tests consist in extracting some fuel rods, cutting and submitting samples to radiographic and metallographic examination, and chemical and mechanical tests.

The Italian Experience

The first Italian NPPs – located in Latina, Garigliano and Trino Vercellese – became critical between 1963 and 1964. The main contractors that supplied the first cores were respectively: British Nuclear Fuel Limited (BNFL), General Electric and Westinghouse. A few years later, some manufacturing activities started in Italy to supply ENEL's nuclear fuel reload.

Initially the main components of fuel assemblies were imported and assembled in small factories such as Combustibili per reattori nucleari (Coren) and Combustibili nucleari (CN). Coren, owned by the firms Breda, Fiat and Westinghouse was based in Saluggia (near Turin) and provided nuclear fuel for the Trino Vercellese NPP; CN,

3 Referring to NPPs, Burnup is the integrated energy released from the fission of heavy nuclides initially present in fuel, and is expressed in Megawatt Days per Metric Ton Uranium Initial (MWD/MTU).

owned by the Azienda Generale Italiana Petroli (AGIP) and BNFL, was based in Rotondella (near Matera) and provided nuclear fuel for the Latina NPP. KRT of Großwelzheim in Germany supplied the nuclear fuel used for the Garigliano NPP.

In 1976, just before the Caorso NPP started operating, the company Fabbricazioni Nucleari (FN) located in Bosco Marengo (near Alessandria) began producing fuel on an industrial scale. The company was owned by a joint venture between Ansaldo, AGIP and General Electric (GE), which was the nuclear fuel designer. FN's fuel production started with the fabrication of Caorso's first core, which was composed of 560 FA, whose components were all manufactured on site, including pellets, grids and end plugs. The top management of FN, the procedures it used, as well as some skilled personnel came from GE.

In 1976, the number of Italian nuclear fuel experts could be counted on the fingers of one hand, given that the tasks one had to face were very difficult and delicate. Upon starting my inspections at FN, I realized that, despite the fact that the firm had adopted the GE quality system, the production standards it followed were not ideal. Its major shortcomings concerned the following aspects:

– operators' qualifications and processes were below standard,
– wrong sampling procedures,
– fabrication methods were not in compliance with design specifications,
– management's serious deficiencies and hostile relationship.

The kinds of wrong procedures that were applied in FN included the X-ray control on the end plugs welding and the control of the fuel rods bow. The end plugs welding ensures that during reactor operations the gaseous fission products are not released by the fuel rods. Therefore, checking the integrity of this welding is extremely important. FN applied a statistical control plan on end plugs welding with X-ray radiography, instead of 100% radiographic tests. This was even more detrimental to the nuclear fuel quality and safety, since the plant was in its first experience of production and manufacturing procedures were not sufficiently proven and reliable.

As far as the rods bow was concerned, the test implemented by FN consisted in rolling the rods on a 5 mm thick bench plate (made of stainless steel). Given that the design tolerance on the rod bow was of 1 mm for the entire length of the fuel rod (about 4 m), it was impossible to check this measurement with accuracy, because the bench plate was subjected to alterations in flatness due to the magnetic field, the temperature range and the roughness. In other words, the margin of error introduced by the bench plate was comparable to the value to be measured.

The correct procedure needs metrology test instruments like granite surface plates, having the following characteristics: 5 m length, 2 m wide, and 2 m high, weighing about 6 tons, flatness < 5 μm (0.000005m). An example of a granite surface plate is shown in Figure 2 below.

Figure 2. Granite surface plate.

Six months after production started, my inspection activities met with success, forcing GE to make an internal audit in which supervisors from the San Josè, California headquarters accepted most of my remarks. The measures that were taken concerned the following aspects:

– replacement of US management,
– change in fabrication methods and sampling procedures,
– change in the quality control plan and standard,
– production re-start.

In the following years, FN achieved good quality standards in nuclear fuel fabrication, attested by the low fuel defectiveness found in Italian NPPs (~ 1-1.5%).

As part of my audit work on nuclear fuel fabrication, I participated in research programs on the behavior of light-water reactors' fuel in plants operating in Italy. In addition to the research programs carried out by the Comitato Nazionale per l'Energia

Nucleare (CNEN), ENEL developed a monitoring activity for the Garigliano NPP (BWR) and the Trino Vercellese NPP (PWR), two of the first power plants ever commissioned.

In the second half of the 1960s, several cooperation agreements between ENEL and Euratom led to a growth of these activities. In particular, the Euratom-ENEL 071-66-6 TEEI- RD and the Euratom-ENEL 092-66-6 TEEI contracts, which focused on PIE. The main objective of PIE was, as mentioned above, the measurement of the burn-up and the isotopic composition of selected fuel samples by means of gamma scanning techniques, in order to evaluate the accuracy of calculation methods applied. One of the aims of the Euratom-ENEL 071-66-6 TEEI-RD contract was the metallographic analysis of the UO2 pellets and the stainless steel cladding.

Initially, 52 fuel elements, 8 of which contained plutonium, were examined in the pool of the Garigliano NPP. Then 2 of these elements were transported to the ESSOR reactor in Ispra, in order to carry out the examination of 26 selected fuel rods, consisting of a complete gamma scan analysis and metallographic tests that were performed both at ADECO laboratories in Ispra and in Karlsruhe. As far as the Trino NPP was concerned, 4 fuel elements were subjected to gamma scanning, all of them transported at different times to the ESSOR reactor, where 49 fuel rods were extracted and examined with gamma scanning and metallographic tests at the Ispra and Karlsruhe laboratories. The irradiated assemblies were dismantled, some fuel rods and pellets were selected - representative of both the unperturbed and the perturbed reactor core region -, and cut from them after gamma scanning. The pellets were then dissolved and submitted to α, γ and mass spectrometry, in order to determine fission-product and heavy-element buildup, isotopic ratio and burnup.

It was the largest PIE program ever performed in Europe on power reactors and, as far as the PWRs of the first generation were concerned, the only one ever performed in the world. Unlike the fuel elements of the Garigliano NPP, those of the Trino NPP had not been designed to be disassembled; they were enclosed in a (perforated) metal casing and welded to the two terminals (upper and lower) to allow handling. In order to remove the fuel rods it was necessary to cut the casing just below the upper terminal (see Figure 3) without affecting the fuel rods: an operation that Westinghouse – which designed the plant – considered impractical, as it would have to be done underwater.

Nevertheless, a special team of ENEL – Centro Progettazioni Nucleari designed and built a structure of underwater cutting and containment, equipped with pneumatic cutters that could be operated manually outside the nuclear fuel pool, which made it possible to complete the operation.

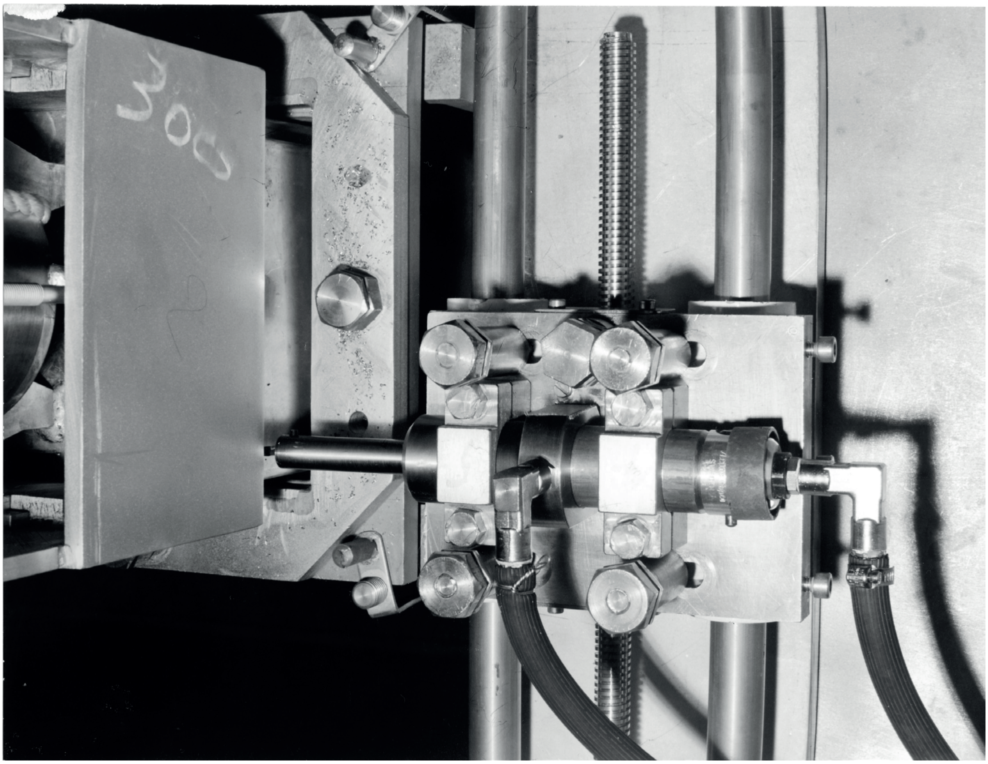

Figure 3. Cutting device: movable slide, air-operated motor.

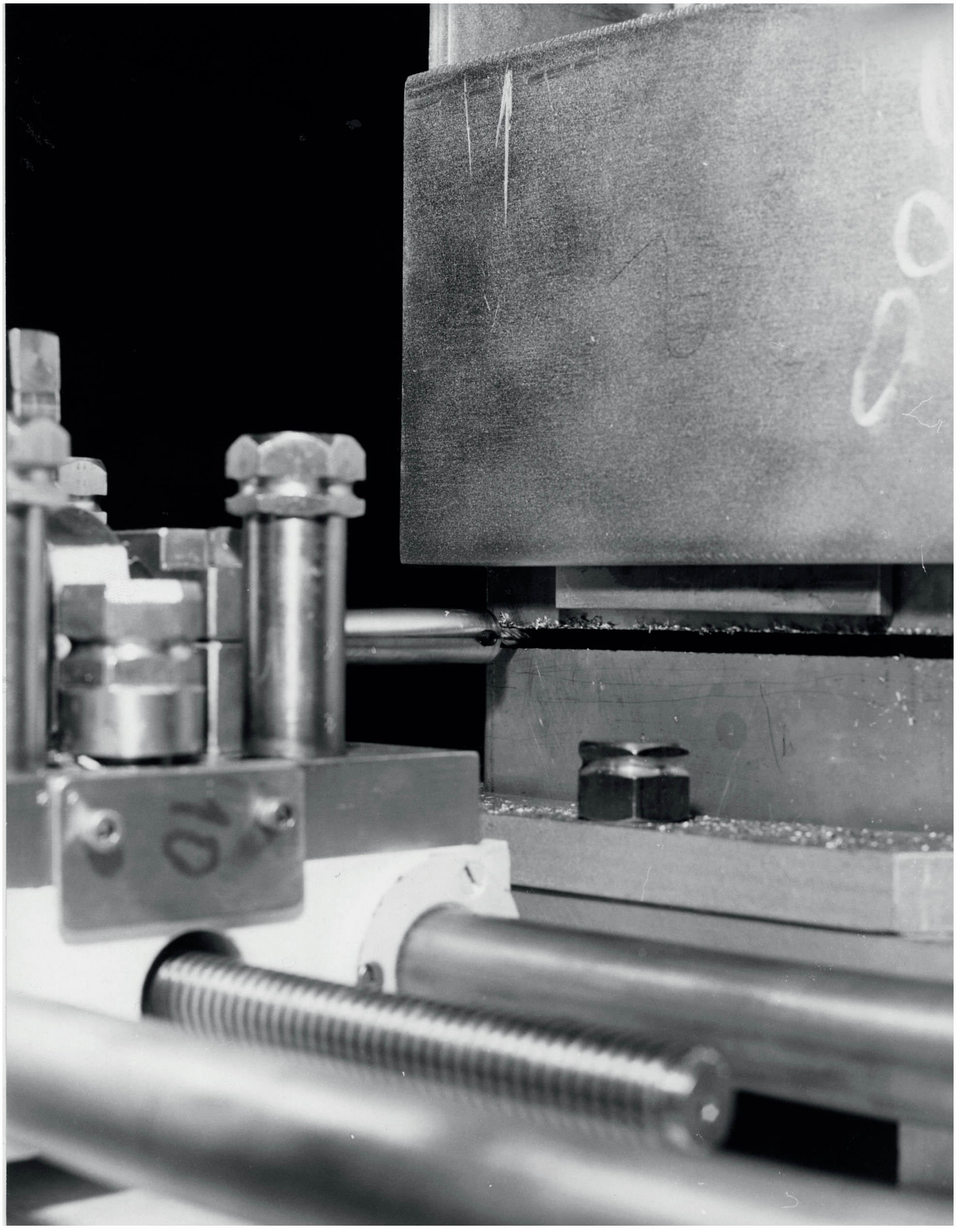

Figure 4. Cutting device: view of cut fuel element.

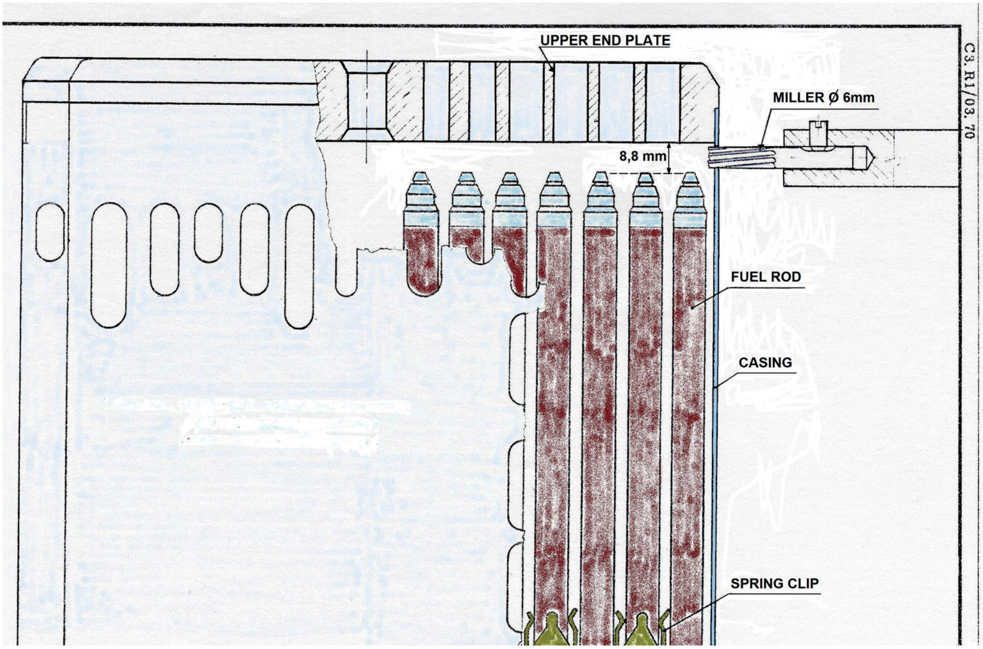

Figure 5. Vertical section of fuel assembly with miller inserted into the casing.

Becoming an Antinuke

When I started working for ENEL, there were many technicians like me who believed that the use of nuclear energy would allow to achieve the objectives set out in the ENEL charter: "To assure, at minimum management cost, the availability of electrical energy sufficient in amount and price to the requirements of a balanced economic development of the country". In other words, many of us believed that the development of nuclear energy was an opportunity to promote the country's development, and were truly excited about our work.

It was only after the 1973 oil crisis that our attitude toward nuclear power changed. The price of oil skyrocketed and so did the orders of nuclear power plants that hitherto had not been economically competitive: the era of cheap energy was finally over. Then we understood we were facing an epochal restructuring of the global energy system, in which the role of nuclear energy would not be "to provide abundant electrical energy in the power-starved areas of the world" – as outlined in the Atoms for Peace program – but to increase the power of the most important energy companies and of the countries that controlled nuclear technology.

Therefore, along with some of my colleagues who shared my concerns about ENEL's nuclear policies, I began an information campaign against the Italian government's plan to build several NPPs, and denounced the links with the field of nuclear weapons that this technology brought with it.

In 1975, on behalf of the government, Minister of Industry Carlo Donat-Cattin presented the Piano Energetico Nazionale, which received support from the Comitato Interministeriale per la Programmazione Economica (CIPE). It was the first national energy plan to be approved by the Italian Parliament and was based almost exclusively on the construction of 20 NPPs totaling 20,000 Mw to be realized by 1985. During the same period ENEL was authorized to participate in a joint venture with EDF of France and RWE of Germany to build Fast Breeder Reactors (FBR), the first of which (Superphénix) was built in France at Creys-Malville.

For us – engineers working in the field – it was a colossal program that did not meet the needs of the moment, but was serving the interests of big energy companies that wanted to obtain contracts with ENEL. Our information campaign was based on the following issues:

– the nuclear program was oversized compared to the forecast of electricity demand. It was a 50 per cent increase in installed capacity over a period of ten years (in 1975 the total installed capacity was 40,000MW);
– ENEL had not provided the necessary funds for such an investment, so a considerable increase in electricity rates was inevitable, especially household rates;
– despite the increase in oil prices, the cost of nuclear KWh was not competitive with that obtained from conventional power plants. Moreover, the experience of the Caorso NPP (then under construction) indicated that the goal of building two nuclear power plants per year was unrealistic;
– the hydrographic and geological configuration of Italy (its seismicity), in addition to its population density, were not suitable for the construction of twenty nuclear power plants. This meant that all plants would be built on the coast, with a significant increase in costs and a penalty for tourist activities;
– the construction of twenty NPPs would have monopolized ENEL's activities and those of manufacturing companies, and would have undermined the search for different technological solutions in the field of electricity generation. Although at the time it was perhaps premature to invest in renewable energy sources, other technologies were developing, such as those related to combined cycle gas turbine and the gasification of residues from oil refining of which Italy had large stocks;
– from the point of view of its economic and social effects, the nuclear program would create many inefficiencies. After an NPP was completed, employment lev-

els would be particularly low, compared to other industries with the same investment. Moreover, in large parts of the territory and along the coasts, agriculture and other activities carried out by local populations would be forbidden;
– last, but not least, building such a large number of nuclear power plants raised two major issues: first, the problem of radioactive waste disposal, which was completely ignored by the National Energy Plan; second, given the considerable quantities of plutonium to be derived from NPP operations and from the Superphénix fast breeder reactor, the connection between the civilian nuclear program and military strategies.

Given the presence of a strong lobby defending the interests of the oil companies against nuclear power, it was not easy for us to explain our position, since we could easily be considered supporters of the oil lobbies. It was equally difficult to communicate with local populations involved in discussing where NPPs should be built. These were composed primarily of ordinary people who asked us (technical experts) to be reassured about the risks of NPPs, while at the same time being attracted by the benefits they could reap if the plants were built. Given the technical expertise we had acquired working in the nuclear field, we did not initially consider the issue of safety as a priority. It was only after the Three Mile Island accident in 1979 that we had evidence of the dangers of these plants and of the entire nuclear cycle. Throughout this period, I continued to carry out my control activities on nuclear fuel, aware of the great delicacy of my work, while at the same time participating in the activities of the anti-nuclear movement, either in public meetings in Montalto di Castro (where two NPPs were to be built), or in conferences at the University of Rome.

These activities were accompanied by the publication of brochures on nuclear technology and on several experiences that were developing in Italy and in other European countries against nuclear power.[4] The anti-nuclear movement, in fact, was perhaps the only transnational movement that affected Europe, and it was a spontaneous movement, not led by parties or large organizations. Most European parties and trade unions were in favor of nuclear power, and this made it more difficult to challenge this policy. Anti-nuclear supporters were often described as obscurantists, enemies of progress and science that wanted to return humanity to a primitive state. The first major event of the Italian anti-nuclear movement was held in Montalto di Castro on March 20, 1977 with the participation of thousands of people coming from various parts of the country. The land where the nuclear plant was to be built was symbolically occupied, and in the

4 *Crisi dell'energia e ristrutturazione* (Roma: cyclostyled by Comitato Politico ENEL, 1973); *Contro la truffa nucleare* (Roma: cyclostyled by Comitato Politico ENEL, 1975); *Le lotte antinucleari in Europa* (Roma: cyclostyled by Comitato Politico ENEL-Comitati autonomi operai, 1977).

following months a unique form of protest emerged, the anti-nuclear organization of campsites. The movement promoted forms of communication with the local population and discussed with them the problems arising from the construction and operation of the NPP. After 1978, "anti-nuclear camping" was organized not only at Montalto di Castro, but also at Nova Siri (Matera), Cerano (Brindisi), and Brasimone (Pistoia), all placed involved in the building of NPPs.

Personally, I ended up in a paradoxical situation, which would be impossible today. On the one hand, ENEL's leadership (which was aware of my anti-nuclear activities) wanted to fire me, or at least give me another assignment. On the other hand, my professional skills prevented ENEL from pursuing its goals, given that I had made a significant contribution to the development of its quality assurance, and had forced the powerful GE to review the Caorso nuclear fuel fabrication management in the Bosco Marengo facility, even receiving praise from GE. Nevertheless, for more than ten years, ENEL's management blocked my career: it was the price I had to pay for my anti-nuclear activities.

This controversial behavior lasted until 1987 when, after the Chernobyl disaster, I opted for a moral objection, and wrote an official letter to ENEL, making my decision public.

This is the letter I wrote to the Office Staff – ENEL Headquarters:

> With this letter I submit a formal request to no longer be used on tasks relating to the design, construction or operation of a nuclear power plant. This decision (which I intend to make public) may possibly appear peremptory, but my professional and social life have reached a point where I find myself faced with choices that can no longer be postponed. For sixteen years now I have dealt with nuclear fuel and in all that time my job has been to control its manufacture: first for Garigliano and Latina, Trino and then Caorso, Cyrene and Alto Lazio. For this work, although quite unusual, I do not feel either a scientist or an expert: simply I know I am a technician who, like many of his colleagues, strives to accomplish a specialized task correctly. But as you know I am also an anti-nuclear activist that for many years has been fighting to change ENEL's energy policy, hence the dilemma that accompanied my job. Now I need to strive for clarity toward myself and toward all those with whom in the past I shared work commitments or ideals of struggle. After all, clarity has always marked, although with conflicting positions, my relationship with ENEL, with which I intend to keep faith even in this difficult choice. I say difficult because if for years I have lived with this burden – acting as an anti-nuclear activist and working as a diligent nuclear expert – it is also because I thought I could put something more into my work that was not strictly contractual: my suspicion, my scruples (and why not, my passion) to work on a component so unequivocal as nuclear fuel. If all this is not enough anymore, it is because after Chernobyl I realized that contributing critically is still cooperating, giving credit to the paradox that nuclear accidents are technologically impossible,

> but statistically probable; but above all it is to forget that the Chernobyl firefighters, accepting a horrible death, prevented an even more serious catastrophe.
> Even though rationally I am convinced that the "nuclear plague" – in some respects – is not worse than the chemical one; although I perceive that the cloud of Chernobyl is used to hide other threats to humanity, I do not mean to endorse anymore – even with my experience – technological choices that are more and more intrusive and oppressive; I will no longer succumb to the engineering cynicism that considers life a "non returnable empty"; I cannot accept the cultural respectability of some scientists who send their banal appeals to reason to the head of state. It's a reason that I do not respect and do not know, because it is a reason that does not think, like the science of which it is the daughter.
>
> Giorgio Ferrari Ruffino, February 1987

My letter was sent to ENEL as well as to several newspapers that were interested in the anti-nuclear movement. I must admit that I was upset by the complete lack of reactions to my position, in particular from the (mostly academic) and widely known experts in the field. I continued to work as a technician for ENEL, although I was dismissed from the nuclear sector - as I had officially requested – and was for several years marginalized from any relevant task. I was later employed in ENEL's foreign activities until I reached retirement.

I never regretted my decision. I was lucky enough to live my "nuclear adventure" with great passion at a time of great industrial planning and research, and with the same passion I participated in the anti-nuclear movement.

Abstracts

Angelo Baracca, Saverio Craparo, Roberto Livi, Stefano Ruffo
The Role of Physics Students at the University of Florence in the Early Italian Anti-nuclear Movements (1975-1987)

Popular movements and public opinion had a crucial role in shaping the fate of Italian nuclear programs. In parallel with the growing technical and safety problems revealed by nuclear technology, they have conditioned (as is obvious) political decisions. The experience that we have reconstructed is significant also for an assessment of nuclear technology, and the relationship between specialists and popular points of view.

In the mid 1970s, a group of students from the University of Florence published one of the first exhaustive books on the subject (*I Nucleodollari*), and developed an active role in the growing Italian anti-nuclear movement, as popular nuclear "experts", alongside professional nuclear experts. Professor Angelo Baracca inherited their experience and public engagement. This activity continued in the 1980s in the anti-nuclear movement, opposing civilian nuclear programs and supporting nuclear disarmament.

Elisabetta Bini
Atoms for Peace (and War): US Forms of Influence on Italy's Civilian Nuclear Energy Programs (1945-1964)

This chapter analyzes the ways in which the United States influenced Italian civilian nuclear energy policies between the end of World War II and the mid-1960s. It argues that until the mid-1950s, when the United States developed its Atoms for Peace program, the US administration remained quite suspicious about Italy's project to develop a civilian nuclear energy program. The State Department and the Atomic Energy Commission (AEC) kept firmly under control Italy's efforts to extract uranium in the North of the country. Their greatest concern was that the Italian government might decide to declare its uranium resources property of the state, like it had done with its hydrocarbon resources. Despite a series of requests from Italian scientists and industrial firms, the Marshall Plan did not provide any funds for the purchase of nuclear equipment. In the context of the Atoms for Peace program and of the signing in 1955 of a bilateral agreement, the United States gained increased influence over Italy's atomic energy policies.

Based on new archival sources from the United States and Italy, this chapter argues that after John F. Kennedy became President, and in the context of the so-called "center-left governments", the US administration supported the expansion of Italy's nuclear program and a greater role of the state in promoting civilian nuclear energy programs. Once ENEL was founded, however, the company chose to rely on oil, rather than nuclear power, to fuel most of its electric plants. Following a series of agreements between Standard Oil (N.J.) and ENI, Italy received large quantities of cheap oil from the Middle East. ENEL's strategy was supported by American oil companies operating in Italy, and endorsed by the State Department as more cost-effective than a full-scale nuclear program. However, important sectors of the US administration remained critical of the rapid decline of Italy's civilian nuclear program, which accompanied these agreements and, most importantly, the marginalization of Comitato Nazionale per l'Energia Nucleare's Secretary General Felice Ippolito after the so-called "Ippolito affair".

Laura Ciglioni
Italian Mass Media and the Atom in the 1960s: The Memory of Hiroshima and Nagasaki and the Peaceful Atom (1963-1967)

The chapter investigates the representations of both fears and hopes related to atomic issues in Italian mass media from 1963 to 1967, through the analysis of a selection of highly circulated mass-market magazines (representing a broad spectrum of political cultures) and of television programs broadcast by the two Italian public networks of the time. The fears of the "atomic age" are analyzed through the memory of Hiroshima and Nagasaki, which represents one of the privileged venues for both molding representations of the atomic bomb and negotiating fears. "Atomic hopes" are investigated, instead, examining the emergent fascination for the peaceful uses of atomic energy, analyzed as the catalyst for a positive perception of the atom at a time when national energy policies were at a crucial turning point.

Lodovica Clavarino
"Many Countries Will Have the Bomb: There Will Be Hell": Edoardo Amaldi and the Italian Physicists Committed to Disarmament, Arms Control and Détente

The chapter analyzes Edoardo Amaldi's commitment to disarmament and détente in Italy during the Cold War and in particular during the debate about the signing of the Non-Proliferation Treaty (NPT). Amaldi (1908-1989) can be considered one of the leading Italian scientists involved in the national and international campaign against nuclear proliferation. In the mid-1960s, a strong civil commitment began to emerge among physicists, as they claimed a voice in Italian security policy, in order to increase public opinion's awareness about the dangers of the nuclear age and to promote Italian accession to the NPT. While it is difficult to assess to what extent Italian scientists' efforts in favor of arms control succeeded in influencing Italian politics during the Cold War, their strong involvement in their country's security policy is in itself a relevant issue for the history of the Italian nuclear experience.

Barbara Curli
Italy, Euratom and Early Research on Controlled Thermonuclear Fusion (1957-1962)

This chapter traces the early origins of European collaboration in controlled thermonuclear fusion research, within the larger picture of Cold War nuclear policy in the late 1950s-early 1960s, and as a consequence of the signing of the Euratom treaty in 1957. It then presents some preliminary findings on the Association contract which was signed in 1960 between Euratom and Italy, in order to carry out research in controlled thermonuclear fusion at the then newly created Laboratori nazionali di Frascati, near Rome, within the framework of the Comitato Nazionale Energia Nucleare (CNEN), the Italian civilian nuclear energy agency.

Mauro Elli
Italy in the European Fusion Programme during the 1980s: A Preliminary Overview

Standard narratives of European integration deem Euratom as a failure and an early application of the logic of *juste retour*. Though this might be broadly correct, there is a major exception, i.e. fusion research. A prominent role in this successful story was played by an Italian physicist, Donato Palumbo, the "visionary father of the European Fusion Programme", as former JET director Jean Jacquinot put it. The story of the fusion program is deeply indebted to Palumbo's recollections as presented in a number of occasions since the 1980s. This chapter sheds light on the relevance of the Italian input – more broadly intended – to the European Fusion Programme, viewed as a story of multiple interconnecting layers at the laboratory, national, European, and international levels.

Giorgio Ferrari Ruffino
A Particular Experience: How a Nuclear Expert Became an Antinuke

Between 1968 and 1987, I was in charge of control activities on nuclear fuel design and fabrication of all nuclear power plants of ENEL. At the same time, I attended to several cooperation agreements signed between ENEL and Euratom focused on Post Irradiated fuel Examination (PIE), which was the largest PIE program realized in Europe on power reactors.

After the oil shock of 1973, my attitude toward nuclear power changed because the role of nuclear energy was not longer the one outlined in the program Atoms for Peace "to provide abundant electrical energy in the power-starved areas of the world". On the contrary, its role become to strengthen the position of big energy companies and of the countries that controlled this new technology. So I became an antinuke. Throughout this period, I continued to carry out my control activities on ENEL nuclear fuel, until 1987 when, after the Chernobyl disaster, I decided for a moral objection, as I wrote in an official letter to ENEL, making my decision public.

Marilena Gala
Italy's Role in the Implementation of the Dual-Track Decision

This chapter focuses on Italy and the intra-alliance dynamics developed by Italy around the adoption and implementation of the dual-track decision of December 1979. In particular, it describes how, starting from a marginal position, sanctioned by the exclusion of the Italian government from the quadripartite summit held at Guadeloupe in January 1979, Rome managed to heighten its political relevance as an Atlantic partner thanks to its status as a non-nuclear weapon state. In fact, in accepting to deploy the so-called Euromissiles on its territory, Italy not only guaranteed the necessary conditions for West Germany's accession to that NATO decision; it also actively participated in Western European efforts to overcome the American initial resistance to pursue the arms control track with the same determination devoted to the nuclear build-up.

Matteo Gerlini
Energy Independence vs. Nuclear Safeguards: the US Attitude toward the European Fast Breeder Reactors Program

This chapter is part of a background research on the history of the Italian fast breeder reactor (FBR) program. During the 1970s, FBRs offered revolutionary perspectives in the energy field. But this kind of technology entailed a higher proliferation risk than other types of nuclear reactors, because of the massive separation of plutonium as FBRs' fuel. The US government concern about this potential risk urged it to turn out all the FBR programs active in the United States, as well to oppose other FBR programs ran by Europeans. Based on existing studies on the history of FBRs, this chapter uses some archival evidence about US President Jimmy Carter's policy toward FBRs, concluding with an assessment of the effect of the International Fuel Cycle Evaluation on this technology.

Giulia Iannuzzi
Italian Science Fiction, Nuclear Technologies: Narrative Strategies Between the "Two Cultures" (1950s-1970s)

This chapter critically investigates how science fiction interacted with, and contributed to the development of a collective imagery related to nuclear energy in Italy between the 1950s and the 1970s, within a context characterized by a difficult relationship between the "two cultures". To do this, it takes into account the theme of nuclear technologies in science fiction genre narratives, and its treatment on the part of non-genre Italian writers. An initial enthusiasm toward nuclear energy is interpreted as part of new hopes connected to an unprecedented modernization in the peninsula and a new centrality of techno-science – of which science fiction was an apt expression. The hostility toward both nuclear technologies and science fiction on the part of the Italian cultural elite during subsequent decades is read as two different sides of the same "malaise of modernity".

Fabio Lavista
Political Uncertainty and Technological Development: The Controversial Case of AGIP Nucleare (1956-1962)

In the second half of the 1950s the Ente Nazionale Idrocarburi (ENI), the main Italian state-owned oil company, founded in 1953, experienced an intense phase of development. It was in this context that in 1956 AGIP Nucleare was established: the new firm, completely controlled by ENI, had the task of establishing a first nuclear power plant in Latina, near Rome, attesting the technical capability of the group and justifying the expansionist ambitions of its top management. This chapter analyzes the case of AGIP Nucleare, focusing on three peculiar aspects: the national political environment that led ENI to foster a strategy that was independent both from private energy enterprises and from other Italian public holdings; ENI's controversial international relations; the pattern followed by ENI to acquire knowledge in the nuclear field. National and international political and technological contrasts resulted in a peculiar development of the Italian nuclear industry: the successful establishment of the first three nuclear power plants, one owned by private enterprises, one by IRI and the third by ENI, was not followed by an effective national nuclear policy that could lead to further developments.

Massimiliano Moretti
A Never-Ending Story: The Italian Contribution to FIG

On November 28, 1957, the Defense Ministers of France, Italy and Germany (FIG) signed a far-reaching secret protocol, which contemplated the possibility of atomic military cooperation. Relying on new archival sources, this chapter investigates Italy's involvement in this ambitious trilateral project. It also examines aspects not strictly pertaining to the nuclear dimension of the endeavor. This narrative attempts to show that the established historiography may have over-estimated the atomic component of the story, by overlooking long-lasting forms of conventional military cooperation. Surprisingly, these attempts at conventional cooperation also reveal other hidden nuclear angles of this strangely polyhedral triangle.

Renato Moro
Against Euromissiles: Anti-nuclear Movements in 1980s Italy (1979-1984)

Between 1981 and 1983, the mobilization against Euromissiles introduced an extraordinary novelty in Italian social and political history. The Italian anti-nuclear movement took off later than in other European countries and its main feature was a politicization unknown elsewhere. The movement developed on the basis of a double and contrary youth mobilization: the first coming from the Communists and the second from the New Left. The movement was not only manifold, but also radically divided about its goals (balanced disarmament vs. unilateralism, atomic weapons vs. nuclear energy, nuclear issue vs. military budget) and methods of protests (pleas vs. conscientious objections, mass demonstrations vs. civil disobedience, referendums vs. tax objections). Continuous disagreements conditioned and weakened the anti-nuclear movement, even when the axis of the protest was transferred to Comiso, to which and from which the PCI and the Radical Party promoted different and contrary marches. Even when, in 1983, a unanimous framework was approved, a common mobilization remained difficult, both in Comiso and in Rome. The movement was only a vast, heterogeneous and divergent coalition, but it expressed a common political base and culture. Neither Communist nor pacifist, but influenced by the New Left protest against traditional political parties, the new culture was rooted in environmentalism, pessimism, nuclear catastrophism, anti-Americanism, new socialism, disarmed unilateralism, and an opposition to everything that resembled traditional politics. The movement worried the Italian government, but it never represented a real political danger and never even succeeded in bringing the nuclear issue to the foreground. Nonetheless, it deeply changed the Italian political culture: it brought new styles and sensibilities, unknown to the traditional left. For the first time, criticisms of ideologies and parties, direct action, civil disobedience and individualism split Christian Democratics from their Catholic grassroots and Communists from the youth.

Leopoldo Nuti
Italy as a Hedging State? The Problematic Ratification of the Non-Proliferation Treaty

Between 1966 and 1975 the signature and ratification of the Non-Proliferation Treaty (NPT) were some of the most momentous foreign policy decisions the Italian government had to make. This chapter is an attempt to provide a plausible explanation for the intensity of the debate that the Treaty stimulated, and more specifically for the long delay between the Italian signing (1969) and the ratification (1975) of the Treaty. It is based on a variety of Italian, American and British sources, namely the personal papers of Aldo Moro, Amintore Fanfani and Giulio Andreotti (respectively stored in the Italian Central Archives, in the Italian Senate's Historical Archive, and in the Historical Archive of the Luigi Sturzo Institute), the papers of the disarmament office of the Italian Foreign Ministry (at the Ministry's Historical Archive), and the papers of the Diplomatic Counsellor to the Prime Minister (at the State Central Archive); the ACDA Director's Office NPT files and the main records of the Department of State (RG 59) at the National Archives at College Park (Maryland), and a number of collections from the British National archives at Kew.

Giovanni Paoloni
Nuclear Energy and Science Policy in Post-war Italy

The first Italian researcher to mention the possibility of producing energy by breaking the energy bonds of atomic nuclei was Enrico Fermi at the end of the 1920s, and the idea echoed during the 1930s and 1940s. After 1945, his students who had remained in Rome, together with other physicists in Milan, Padua and Turin, created the Istituto Nazionale di Fisica Nucleare (INFN) (1951), and participated in the Italian nuclear committee CNRN, then nuclear agency CNEN-ENEA. While trying to promote the development of nuclear power in Italy, the nuclear committee subsidized the INFN and created research centers for applied nuclear research and for particle physics. The committee also became involved in other fields (such as genetics and molecular biology), and in programs to improve science education and the public understanding of science. All these commitments, notwithstanding some ambiguities, played a key role in shaping the scientific environment of Italy during the 1950s and the 1960s. With all its limitations, the Italian nuclear program was an important driver for industrial innovation and scientific research, well beyond the boundaries of closely related fields, and its crisis after the "Ippolito affair" in 1963-1964 hit the Italian research and development system deeply.

Carlo Patti
An Unusual Partnership: Brazilian-Italian Forms of Cooperation in the Nuclear Field (1951-1986)

This chapter discusses the Brazilian-Italian cooperation in the nuclear field between the early 1950s and 1986. Since the late 1930s, Italian or Italian-Brazilian scientists promoted the development of studies in nuclear physics. Immediately after World War II, the Brazilian-Italian collaboration continued. Between the 1950s and the 1970s, Brazilian nuclear scientists studied in Italian institutions. Relying on primary sources from Brazilian archives and oral history interviews with protagonists of the Brazilian nuclear program, this chapter explore the relations between Italy and Brazil from 1951, the year of the establishment of the Brazilian nuclear program, until the 1980s. This study focuses on the bidirectional transfer of knowledge on sensitive technologies, and on the formal and informal cooperation between the two countries.

G. B. Zorzoli
Did the Italian Decision Makers Understand that Nuclear Is Not Business as Usual?

In the 1950s, the confrontation on the nationalization of the electricity power system and the belief that nuclear energy would reach a dominant share in electric power production induced many Italian players to enter the nuclear business. After the nationalization of the electricity power system in 1962, even ENEL was not interested in continuing building nuclear plants. After the 1973 oil crisis, an ambitious nuclear program was issued, which omitted any choice on technologies, any information on plant siting and on the sharing of responsibilities among operators. The only decision taken was the commissioning of a boiling water reactor plant, which was never completed: after the 1987 referendum the Italian Parliament, besides stopping the building of new nuclear plants, closed the existing units. The 2008 farcical attempt to revamp nuclear power was defeated by the 2011 referendum.

Contributors

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Elisabetta Bini is assistant professor of Contemporary History at the University of Naples Federico II. Between 2014 and 2016, she was a research fellow at the University of Trieste, where she coordinated the Nuclear Italy Research Group (NIREG). Her publications include: *Atomi per la pace? Gli Stati Uniti e le politiche nucleari dell'Italia durante la Guerra fredda* (Roma: Carocci, forthcoming); *La potente benzina italiana. Guerra fredda e consumi di massa tra Italia, Stati Uniti e Terzo mondo (1945-1973)* (Roma: Carocci, 2013); edited with Federico Romero and Giuliano Garavini, *Oil Shock: The Crisis of 1973 and its Economic Legacy* (London: I.B. Tauris, 2016); edited with Igor Londero, "Nuclear Energy in the 20th Century: New International Approaches", special forum, *Contemporanea* 4 (2015); "Fueling Modernization from the Atlantic to the Third World: Oil and Development in ENI's International Policies, 1950s-1960s", in *L'Europe et la question énergétique. Les années 1960-1980*, eds. Alain Beltran, Eric Boussière and Giuliano Garavini (Bruxelles: Peter Lang, 2016); "Histories of Energy in the Transatlantic Century: European and American Perspectives", in Maurizio Vaudagna, ed., *Reinstating Europe in American History in a Global Context* (Torino: Otto, 2015); "A Transatlantic Shock: Italy's Energy Policies between the Mediterranean and the EEC, 1967-1974", *Historical Social Research* 4 (2014).

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Mauro Elli, Ph.D., has been the receipient of post doctoral and senior research grants from the Universities of Milan and Padua. He is currently a research fellow at the Centre for Foreign Policy and Public Opinion Studies in Milan and a member of UMR IRICE *Identités, Relations internationales et civilisations de l'Europe* in Paris.

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Giorgio Ferrari Ruffino worked in the ENEL nuclear sector from the 1960s to 1987. He was in charge of control design and fabrication of nuclear fuel for all ENEL's power plants. During his activities he participated in several research programs on post-irradiated fuel examinations.

In the 1970, he became an antinuke, and after the Chernobyl accident he made a moral objection and requested ENEL to abandon its nuclear activities.

In the 1970s, he collaborated with energy and environment journals including *Rosso Vivo* directed by Dario Paccino. With Angelo Baracca he wrote the book *SCRAM, ovvero la fine del nucleare* (Milano: Jaca Book, 2011).

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(Italia, Spagna, Francia) (Brescia: Morcelliana, 2004); edited with Giuliana Di Febo, *Fascismo e franchismo. Relazioni, immagini, rappresentazioni* (Soveria Mannelli: Rubbettino, 2005); edited with Luigi Goglia and Leopoldo Nuti, *Guerra e pace nell'Italia del Novecento. Politica estera, cultura politica e correnti dell'opinione pubblica* (Bologna: il Mulino, 2006); *La formazione culturale e spirituale di Aldo Moro negli anni della FUCI* (FUCI, 2008); edited with Francesca Cantù and Giuliana Di Febo, *L'immagine del nemico. Storia, ideologia e rappresentazione tra età moderna e contemporanea* (Roma: Viella, 2009); edited with Daniele Mezzana, *Una vita, un paese. Aldo Moro e l'Italia del novecento* (Soveria Mannelli: Rubbettino, 2014). He is currently working on a book on the history of peace movements.

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