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Communicating Science in 20th Century Europe

A Survey on Research and Comparative Perspectives

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Introduction

The most difficult terrain is probably that where we erroneously believe that we are on familiar ground. In the case of the interpolation, however, we tend to make between the mode of science popularization, that is so well-known to us historians of science for the 19th century, and the contemporary information or knowledge society this may turn out not to be accurate. Research in a new terrain thus needs to start with inspection. In this sense this collection of papers invites the reader to a tour that explores varied paths in the wide landscape of 20th century popular science.

The preprint documents a symposium on "Communicating Science in 20th Century Europe: Comparative Perspectives" held on 28 July 2009 and organized by Leszek Zasztowt and myself. It was part of the 23rd International Congress of History of Science and Technology in Budapest that took place from 27 July to 2 August 2009. This symposium probably gathered for the first time a larger group of international scholars in order to deal with popular science and science communication in the 20th century. The idea to such a meeting goes back to discussions with Agustí Nieto-Galan at Oxford, when the sixth joint meeting of the British Society for the History of Science, the Canadian Society for the History and Philosophy of Science, and the History of Science Society considered in July 2008 the topic "Popularizing Science in 19th Century Europe: Comparative Perspectives" in a smaller session.

Meanwhile in an *ISIS* focus section on "historicizing 'popular science'" it was in particular Andreas Daum who pointed at three severe imbalances of the field, that might be stated in a very simplified manner as: too much science, too much English and too much 19th century.[1] In a sense, this preprint is a response to exactly these problems (although the symposium planning predates the paper).

As it turned out after a full day of presentations and discussions in Budapest, the topic of the 20th century was much too rich and multifaceted than to allow reaching a definite picture already after nine wonderful talks; but a discourse was established that is ongoing.

The present collection of papers – some of them close to the original presentation, some of them already more expanded and elaborated – hence serves the purpose to *document* existing knowledge, scholarship, research perspectives and questions. The papers rather mark the beginning of an effort still to be made to integrate, compare and interpret the multiple roles of science in 20th century culture. For this reason we abstain from any global synthesis at this time as the right classification scheme – the equipment the traveler through the many communicative spaces of science would need – is not yet available, but the topis is on the table.

It were very fortunate circumstances allowing that besides the scholars planned to participate in the symposium further contributions could be added. While Agustí Nieto-Galan, James T. Andrews and Tibor Frank could not attend the symposium but kindly provided papers for this collection, also scholars who were not speakers of this particular symposium but had relevant

1 Andreas Daum: Varieties of Popular Science and the Transformations of Public Knowledge: Some Historical Reflections, Isis 100 (2009), 319-332, on 322.

talks in other sections, like Nestor Herran and María Boscá, joined our effort and provided additional pertinent contributions. The individual papers present, whenever possible, not only the historical analysis but also display quality and character of the sources they use, which turn out to be a wealth of material often hardly exploited. For this reason also a number of illustrations have been included and in addition available collections and databases are mentioned.

Clearly, these roughly 200 pages cannot be complete in any sense. Science in film and on TV is obviously one of the biggest white spots here, which can be only half-way justified with the growing attention it has received in recent times elsewhere.[2]

The preprint is organized as follows:

The *first section* starts with the analysis of newspapers and at the very beginning of the 20th century. However, newspaper science is here not approached from the better known press of the strong science nations but rather from the periphery. Drawing on their insights that were gained from the STEP initiative (Science and Technology in the European Pheriphery)[3] Papanelopoulou, Mergoupi-Savaidou and Tzorkas provide some methodological and historiographical reflections that are complemented with the analysis of a full newspaper issue after the event of Halley's comet in May 1910.

Simões, Carneiro and Diogo in turn compare three Portuguese newspapers and their coverage of earthquakes and volcanoes. Besides regional difference of interest, writing on science in the newspaper served both to affirm Portuguese science and scientists internationally as well as a means to translate political and cultural issues to a less problematic level.

Switching to popular science journals, Nestor Herran studies in detail the representations of radium and radioactivity in the Spanish *Ibérica*, while Maria Bosca comments on the popularization of atomic and quantum physics in the same journal. While Herran carefully investigates also the Jesuit context of the journal and considers processes of appropriation of science, Boscá highlights physics content and journalistic forms of science communication in *Ibérica*.

The *second section* about 20th century publishing and learning phenomena collects four papers on four countries and spans over the full 20th century. Agustí Nieto-Galan deals with the phenomenon, that scientific backwardness of peripheral Spain at the turn to the 20th century did not at all entail low activities in science popularization. Rather did the lack of clear boundaries between publications of popular volumes, educational writings and textbooks result in a dynamic setting that allowed to mobilize popular science as means for institutionalization of professional science. Nieto-Galan exhibits various mechanisms for this kind of phenomenon by discussiong the cases of Darwinism, astronomy and thermodynamics and hence of three protagonists Odón de Buen, Josep Comas Sóla and José Echegaray. These examples

2 See e.g. Ramón Reichert: Im Kino der Humanwissenschaften. Studien zur Medialisierung wissenschaftlichen Wissens, Bielefeld 2007; Dorit Müller: Präsentationsformen von Wissen im Lehr- und Kulturfilm der Weimarer Republik, Non Fiktion. Arsenal der anderen Gattungen 2 (2007), 34-46; Timothy Boon: Films of fact. A history of science in documentary films and television, London 2008; and related activities of the "History of Scientific Observation" group of the MPIWG dealing with film.

3 http://www.cc.uoa.gr/step/

show at the same time how different bodies of popular knowledge were translated, both in terms of language and in terms of adaption to particular Spanish cultural conditions as, e.g., the strong role of the Church.

In his brief account on the British developments Peter Bowler, who has just provided a comprehensive account in his new book, points at an overlooked issue in the history of science popularization: the phenomenon of self-education through authoritative print material. This acquired great importance in the years before the Great War and even survived World War II. Here not journalists but scientists engaged in popular writing (also to improve their low academic salaries), a finding that challenges accounts of a story of simple increase in professionalization.

Tibor Frank in contrast describes the Hungarian development as a learning phenomenon of transnational knowledge exchanges and exported traditions. The learning experiences of Hungarian scholars are reconstructed using autobiographical accounts.

In his analysis of the impact of the collapse of the Soviet Bloc on popular science publishing in Poland, Jarosław Włodarczyk demonstrates the phenomenon of a dramatic change from one mode of science publishing to another as it can be read off from quantitative indicators as number of titles, print runs and percentages of translations. Whether this is just the adaption to a Western model is a question that probably should be answered by historians.

The papers of the *third section* consider the political dimension of science communication. James T. Andrews gives a brief outline of the Soviet model which is always understood as the exemplar for the Eastern European countries. Andrews, however, reminds us of the fact that even the Soviet development is marked by stark redefinitions, e.g. by Stalin's technologically oriented popularization campaign from 1928.

Leszek Zasztowt also considers the Soviet model when he tries to analyze the Polish development, but he clearly shows how independent and dwelling on various European traditions Poland followed its own path of science communication. Using contemporary art Zasztowt conveys a suggestive interpretation that leads, among others, to the insight that science communication also was a factor in the collapse of the communist system.

Andrée Bergeron's paper read at the Budapest symposium dealt with the same decades of the 20th century but finds a very different *culture scientifique et technique* that is implemented by a redefinition of French science policy. The French understanding and interpretation of science and public in terms of 'publicisation' turns out to be rather difficult to subsume it in the set of modes that have been generalized from the research on English and German speaking communities. Here we can only present her abstract and a reference to a recent publication, as it turned out to be much more difficult to adequately present the French conception to an international audience.[4]

Oliver Hochadel brings us finally to our present times and looks on the ongoing use of science communication for building a Spanish national identity. Human origins research, it seems, cannot be pursued as a purely scientific project anymore. Not only is 'medialization' an indispensable part of the scientists' work, Hochadel's analysis of 27 books on Atapuerca moreover

4 The author, however, is currently trying to accomplish this and will present her account elsewhere.

finds a common narrative that both renders Spanish paleoanthropology respectable in the international arena and even defines a new beginning of Spanish history.

The question of the *fourth section*, how one could extend the analysis of science communication 'beyond print', receives here only two preliminary answers. Trying to locate the German history of radio and science communication within a diverse array of models that can be found worldwide, Schirrmacher notes that German radio in the Weimar Republic had nothing democratic or liberating. Rich supply of programs on science and technology in a fully state-controlled radio corresponded to the educational values of a *Kulturnation* that would fight trash and dirt in new media, first in film after bad experiences then on the radio proactively.

Daniel Raichvarg, finally, pushes the inquiry further to the presence of popular science in the French day-to-day life and looks beyond educated classes. Juxtaposing shows in *café concerts* and broadcasts on the French radio of the 1920s and 1930s, Raichvarg observes a permanent mixture of contexts and forms within which science is embedded into culture.

The *appendix* documents the general discussion of the Budapest symposium, draws a preliminary landscape of 20th century science periodicals and provides some guidance to a selection of literature.

I would like to express my gratitude in particular to Jürgen Renn for his encouragement and support. I thank Agustí Nieto-Galan for early discussions, that had shaped the project considerably, and Leszek Zasztowt both for close collaboration and for hospitality during a stay in Warsaw in December 2008.

Arne Schirrmacher, Berlin in November 2009

Science Imprints:

Science Content and Genres of Newspapers, Journals and Books

Methodological and historiographical reflections on the use of newspapers in the history of science: The Greek case, 1900-1910

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Newspapers in the history of science

Newspapers are often employed as archival sources in historical research despite debates over their use.[1] Regardless the difficulties in handling such a material, historians and social scientists make frequent use of newspapers not only for they create a "graphic picture of society" but also for they provide an amazing wealth of information that cannot always be retrieved from other kind of sources.[2] As Jerry W. Knudson has remarked "newspapers contain so many different types of material that no simple statement about their value is possible".[3] Indeed, editorials and opinion articles, political, economic and social news, parliament reports, official notices, press conferences, interviews, illustrations and political cartoons, commercial advertisements, obituaries etc are some of the diverse types of material to be found in newspapers. Historians usually select specific types of newspaper articles in order to gather information about political and ideological trends, patterns of social attitudes, images of race, class, gender and national identities, consumerism cultures, local communities, minority groups, lives of individuals, urbanisation, historical earthquake or flood data etc.

The use of newspapers in the history of science is a less common practice.[4] Historians of science have stressed the emergence of a mass market for science from the second half of the 19th century, boosted by the introduction of new technologies in publishing production, the broadening of the learned middle class public, and the adoption of commercial strategies.[5] Discussions on the role of mass media as historical material for understanding the place of

1 Some of the most frequent questions addressed by historians are whether the daily press can provide factual validity, if it is a carrier of no more than biased views or whether it can accurately represent public opinion. For a report of a the various uses of newspapers by historians and social scientists see Jones, A., 'The many uses of newspapers', *Technical report for IMLS project- "The Richemond Daily Dispach".* http://www.perseus.tufts.edu/hopper/publications [accessed on 20/04/2008].

2 Maynard Salmon, L., *The Newspaper and the Historian* (New York, 1923).

3 Knudson, J.W., 'Late to the Feast: Newspapers as Historical Sources', *Pespectives*, 31 (1993): 9.

4 On a discussion of the uses of newspapers in the history of science see also Papanelopoulou F., Kjaergaard, P., 'Making the Paper: Science and Technology in Spanish, Greek and Danish Newspapers around 1900', *Centaurus*, 51 (2009): 89-96.

5 Brock, W. H., 'The Development of Commercial Science Journals in Victorian Britain', in Meadows, Jack, *Development of Science Publishing in Europe* (Amsterdam, 1980); Lightman, B. (ed.), *Victorian Science in Context*, (Chicago and London, 1997).

science in society have emerged through a renewed interest in reconsidering the historiography of science popularisation and that of popular culture. Built on previous criticism on the 'diffusionist model',[6] recent scholarship has attempted to re-introduce the so-far marginal field of science popularisation in a reconceptualised history of science based on the concept of 'knowledge in transit'.[7] Most recently, the Focus section in *Isis*, under the direction of Jonathan Topham, has raised questions related to the consequences of historicizing 'popular science' or what Andreas Daum has appositely called 'a changing set of processes, practices and actors that generate and transform public knowledge across time, space and cultures'.[8] On what concerns the 19th century mass media, perhaps the most comprehensive approach comes from the 'Science in the Nineteenth-Century Periodical Project'[9]. In order to attain a wider understanding of the place of science in the 19th century, and to address the increasing diversity of reading audiences, SciPer's research team has decided to study the full range of periodical types. Moreover, by paying attention to the entire contents of the periodicals, they showed that science, technology and medicine did not appear only in scientific articles, but permeated discussions on various topics related to Victorian culture and history.[10]

Like periodicals, the daily press can be equally seen as a particularly suggestive source for the public images of science and technology and the public perception of their role in society. Unlike periodicals, newspapers are characterised by a less elaborate genre of writing, less coherent contents and less readily identifiable editorial agendas. Recording the daily pulse of life, newspaper articles are characterized by spontaneity, directness and liveliness and can, therefore, be considered to reflect the immediate response of the public to the daily news. Moreover, newspapers often contain a variety of views and opinions that do not necessarily agree with each other, but capture the multiple dimensions of the political and social climate of a certain period.[11] Although, these points have already been exemplified by the work of historians and social scientists, their articulation from the point of view of the history of science is important on two counts. One the one hand, it is important to stress the richness of the daily press as an archival material, and legitimate its complementary or even autonomous use in the history of science. On the other hand, the extent to which science and technology are topics that permeate the entire newspaper and are not limited to specific columns dealing with sci-

6 Hilgartner, S., 'The Dominant View of Popularisation: Conceptual Problems, Political Uses', *Social Studies of Science*, 20 (1990): 519-39; Cooter, R., Pumfrey, S., 'Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture', *History of Science*, 32 (1994): 237-67; Shinn, T. and Whitley, R. (eds), *Expository Science: Forms and Functions of Popularisation* (Dordrecht, 1985).

7 Secord, J., 'Knowledge in Transit', *Isis*, 95 (2004): 654-72.

8 Daum, A.W., 'Varieties of popular science and the transformation of public knowledge. Some historical reflections', *Isis*, 100 (2009): 319.

9 See www.sciper.org [accessed on 12/04/2008].

10 The initial study of the SciPer project has been published in three collective volumes and is the result of a multi-disciplinary approach, drawing from the history of popular science, cultural and literary studies and periodical studies. See: Cantor, G. et al., *Science in the Nineteenth Century Periodical: Reading the Magazine of Nature*, (New York, 2004), Cantor, G. et al., *Science Serialised: Representations of the Sciences in Nineteenth-Century Periodicals*, (Cambridge, Mass., 2004), Henson, L. et al. (eds), *Culture and Science in the 19th Century Media* (Aldershot, 2004).

11 Δρούλια-Μητράκου, Ε., 'Ο Τύπος ως Εργαλείο Έρευνας [The Press as a Tool of Research]', in Droulia, L., *La Presse Grecque de 1784 À Nos Jours. Approches Historiques et Théoriques. Actes du Colloque International. Athènes, 23-25 Mai 2002* (Athènes, 2005).

ence popularisation, is indicative of the important role science and technology played in the formation of modern societies.

Methodological concerns

The legitimisation or activation of a new historical source goes hand in hand with methodological concerns about its exploitation. Based on empirical research conducted on two Greek newspapers during the first decade of the 20th century, we would like to underline the importance of taking advantage one of the most prominent characteristics of newspapers: their *daily* frequency.[12] Because of the diverse and vast amount of information contained in newspapers, it is often tempting to use sampling techniques or statistical approaches, as usually employed in the social sciences for quantitative and qualitative analysis. However, apart from the fact that there is no convincing criteria with respect to which sampling could be decided, one of the main reasons for choosing to go through the whole body of the newspapers is that sampling prevents the thorough study of various issues that appear in daily sequences. For example, the occurrence of an earthquake will result in a large number of articles in a relative short period, and this fact becomes an additional characteristic of the discourse developed by the journalists concerning themes in science and technology.

Moreover, it is important to note that in order to examine the place of science in modern society, one has to examine the *entire* body of the newspaper without limiting oneself to specific types of articles dealing exclusively with science.[13] Our work on the Greek daily press has shown that the news about science and technology together with the journalists' views were spread throughout the newspaper. Opinion articles usually referred to news items about local, national and international scientific issues. Popular science articles appeared on the occasion of news involving scientific or technological events, such as the monitoring of an earthquake or the flight of an airplane. International news items were published to enrich information on local scientific or technical issues. Reports and letters became the platform for public debate offering important information about scientific and technical parameters of political, social and economical issues. It is this complexity that should urge historians to study the entire body of the newspapers rather than deciding to sample articles.

In addition, it is important to examine the relative significance these different articles acquire according to their positioning within the body of the newspaper. Articles on the front page situated near illustrations, or relative to headlines attract more attention than short news-items that are scattered in the middle pages among a great number of advertisements. This is part of the editorial agenda of the newspaper, which is, of course, to some extent, restricted by the physical characteristics of the medium itself. Moreover, it is often the case that the same event, such as the 1908 earthquake in Messina, is treated in various kinds of articles of the same issue. The different points of view of the journalists, the different ways in which they

12 Our empirical study is exposed in detail in Mergoupi-Savaidou, E., Papanelopoulou F., Tzokas, S., 'The public image(s) of science and technology in the Greek daily press, 1908-1910', *Centaurus*, 52 (2009): 116-42.

13 This is an approach usually adopted within the Public Understanding of Science programme. See for example Bodmer, W. F. (ed.), *The Public Understanding of Science* (London, 1985); Dimopoulos, K. and Koulaidis, V., 'The Socio-Economic Constitution of Science and Technology in the Greek Press: An Analysis of Its Presentation', *Public Understanding of Science*, (2002): 225-41.

highlight the news, the different connotations and meanings they prescribe to science may produce a multiplicity of images, often complementary but sometimes contradictory as well, which obliges the reader to actively process the information offered. In this respect, readers are not passive receptors of the views presented in the newspapers.

What is imperative in studies dealing with newspapers is an examination of reading practices related to newspapers. It is interesting to note that for the period we have examined we get some information about the reading practices of the audiences from the newspapers themselves. In their daily chronicles, journalists often described how the Athenians discussed in coffee shops or taverns the news of the day. On the return of Halley's comet, for instance, one journalist observed that popular science articles on Halley's comet were read and then discussed in coffee shops, taverns and other public spaces. As he characteristically said the comet left behind a great number of 'astronomers' who continued to support their theories over a cup of coffee.[14] Unfortunately, the process of 'literary replication' that James Secord advanced for the *Vestiges* is not helpful here, since newspapers are by definition ephemeral publications that are read, discussed, and perhaps thrown away the same day, or used as cheap paper for other purposes in everyday life.[15] Traces of reading practices, discussions over the news of the day, and generally the circulation of newspapers among various social strata can be found mostly in indirect sources and photographic material.

Political, Social and Economic parameters of the daily press:
The Greek Daily press, 1870-1915.

One of the main questions historians of science could ask when dealing with newspaper material is how do the main political, social and cultural features of a period, as well as the ideology that goes with them, influence the public discourse about science and technology, and how in turn do discussions about science and technology in the public sphere transform the ideological, social and cultural formations of each historical period. Does the acknowledgment of this dialectic relation allow us to consider the history of science as a privileged prism through which to re-examine certain aspects of political, economic, social and cultural history?

Historical research on the presence of science in the daily political press invites the historian to take into account various periodizations concerning the history of the press, the political, social and cultural history of the country (since the press deals mostly with political and social news) as well as the history of science. In what follows we will use examples from the history of the Greek daily press, in order to further reflect on the role newspapers can play in the history of science.

At the end of the 19th century the production of the daily press benefited from the development of new technologies that were related to publishing production, such as the introduction of the rotary printing press and the Linotype, the acceleration of the transmission of news via the network of telegraphy and the advent of the wireless telegraphy, the distribution of the

14 Διαβάτης [Diavatis], (1910b, 6 May) Χρονογραφήματα: Ο Μεσίτης [Chronicles: The agent]. *Εμπρός*, p. 1.

15 Secord, J., *Victorian Sensation: The Extraordinary Publication, Reception and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago, 2000).

press through advances in transportation etc. Like in the rest of Europe, these changes affected also the Greek market. Historians usually discern two periods in the early history of the Greek daily press, which are closely related to changes in the political scene of the country. The first period spans from the foundation of the Greek State in 1830 until around 1870, and is characterised by the publication of what is usually referred to as 'journal d' opinion' on a periodic (but not a daily) basis.[16] The second period begins around the end of the 1870s, marked by the programme of modernisation set forth by PM Harilaos

Trikoupis, and goes up, at least, until 1915 with the emergence of the National Schism.[17] The conflict between King Constantine and PM Eleftherios Venizelos over whether Greece should enter Word War I, polarised the daily press in supporters of the King and supporters of Venizelos' Liberal party.

The features of the Greek daily press from 1870s onwards were determined by the specific political, economic, social and cultural characteristics of the period. The emergence of a new political scene, with an emphasis on parties rather than dominant ideologies, rendered newspapers organs of political propaganda and intervention.[18] New printing techniques contributed to an important increase in the quantity and quality of newspapers produced. The introduction of new means of handling information, such as the use of the network of telegraphy, the collaboration with correspondents in urban centres in Greece, Europe and the East, the emergence of new kinds of journalistic discourse, such as reporting, brought closer the Greek daily press to the emerging style of 'journals d'information'. Moreover, the construction and expansion of the railway system of the country and the foundation of the first agency of newspaper sellers facilitated the distribution of the newspapers. The collaboration of newspapers with important personalities from literary circles increased their status, and at the same time the simplification of the language used, with the introduction of forms closer to the vernacular, rendered them more appealing to the public. Lastly advances in the networks of communication and transportation contributed to the circulation of news and ideas outside Greece, and within the reach of the Greek Diaspora, which in turn could facilitate the creation of a coherent national ideology.

The period 1900-1910 is particularly important for the constitution of the Greek political national press and the formation of public opinion. It was a period during which new political and social currents clashed with established social groups and increased social and political

16 The term 'journal d'opinion' is often being used to describe the French daily press, and is usually employed in opposition to the term 'journal d'information' which is considered to characterise the British and American daily press. The 'journal d'opinion' usually refers to newspapers that include commentaries, analyses and opinion articles, whereas the 'journal d'information' is characterised by the predominance of 'universal and true telegraphic information'. Martin, L., *La Presse Écrite En France Au XXe Siècle* (Paris, 2005), p. 37.

17 The National Schism occurred around 1915 when German-raised Danish King Constantine disagreed with PM Eleftherios Venizelos, who supported the Allies, over whether Greece should enter the First World War. The roots of the conflict were of course deeper, and went back to decisions taken during the Balkan wars and the Macedonian Question. See also: Βερέμης, Θ., Κολιόπουλος Γ., *Ελλάς. Η σύγχρονη συνέχεια από το 1821 μέχρι σήμερα [Greece. The modern sequel from 1821 until today]* (Αθήνα, 2006).

18 Hering, G., *Τα πολιτικά κόμματα στην Ελλάδα 1821 – 1936 [Political Parties in Greece 1821-1936]*, (Αθήνα 2004), p. 659; Λούλος, Κ., *Ιστορία και Τύπος: Οι αθηναϊκές εφημερίδες και η περίπτωση του σκανδάλου των εξοπλισμών του 1907 [History and the Daily Press: Athenian newspapers and the scandal of weaponry in 1907],* (Athens 2006), p.183.

tensions, which culminated in 1909 with the military revolt at Goudi.[19] These tensions boosted the mass circulation of the daily press, which became one of the main sources of information and reflected public dialogue on these issues.[20] This period, also characterised by similar European and international developments leading to the First World War, is considered to be a seminal point for the history of propaganda, communicational culture as well as the process of the integration of the masses in political participation.[21]

Revisiting the Centre and Periphery question through the Daily Press

The high numbers of circulation for the most popular and long-lived Greek newspapers, between 3,000 to 10,000 copies during the first decade of the 20th century, is indicative of the wide popularity the daily press enjoyed.[22] These numbers are quite impressive given the high percentage of illiteracy (around 50%) afflicting the country.[23] Similar numbers are to be found in Spain, whereas at the turn of the 20th century we know that 81% of Danish households subscribed to a daily newspaper.[24] Although there are differences in every local context, a question that is perhaps worth answering is to what extent can newspapers be seen as privileged media for the examination of the cultural meanings of science and technology in countries of the 'European periphery'?

Although there is a wealth of archival material and tools available for the examination of the circulation of knowledge between countries of the so-called European centres and peripheries, historians of science seem to have neglected perhaps one of the liveliest, but perhaps most difficult, representatives of the past.[25] Based on empirical evidence, we can state with some certainty that the proliferation of discussions about science in a political newspaper is indicative of the important role science and technology played in the formation of modern Greek soci-

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19 During the first decade of the 20th century political and social unrest culminated in the revolt of a group of military officers in 1909. The Military League, which protested against the neglect of the country's military defence, gained also the support of the public and the trade unions, who strived for social and political reform. This military revolt brought, in 1910, into power the Cretan politician Eleftherios Venizelos(1864-1936), who presided over a vigorous programme of constitutional, military and social reform and represented the hegemonic national ideology until the defeat of Greece in the Greek-Turkish war in 1922, which eradicated any aspirations for territorial expansion in Minor Asia. See Clogg, R., *A Concise History of Greece* (Cambridge, 1992).

20 Μπασάντης, Δ., *Ο Ημερήσιος Τύπος από τον 18ο στον 21ο αιώνα [The Daily Press from the 18th to the 21st century]* (Αθήνα, 2002), p. 62.

21 Μπάλτα, Ν., Παπαδημητρίου, Δ., *Σημειώσεις για την Ιστορία του Ελληνικού Τύπου. Η Ελληνική και η Ευρωπαϊκή Διάσταση [Notes on the History of the Press. The Greek and the European Dimension]* (Αθήνα, 1993), p. 36.

22 Μάγερ, Κ., *Δημοσιογραφικά Ανέκδοτα* [Unpublished Stories from the Greek Press], (Αθήνα, 1972), p. 143.

23 Ψυχογιός, Δ., *Έντυπα Μέσα Επικοινωνίας* [Printed Media of Communication], (Αθήνα, 2004), p. 377.

24 See González-Solva, M., Herran, N., 'Ideology, Elitism and Social Commitment: Alternative Images of Science in Two fin de siècle Barcelona Newspapers', *Centaurus,* 51 (2009): 97-115 and Andersen, C., Hjermitslev, H.H., 'Directing Public Interest: Danish Newspaper Science 1900-1903', *Centaurus,* 51 (2009): 143-67.

25 Apart from the special issue on 'Science and Technology in Spanish, Greek and Danish Newspapers around 1900', *Centaurus*, 51 (2009): 89-173 see also González-Silva, M. 'With or without scientists. Reporting on human genetics in the Spanish newspaper El País, (1976–2006)' in Papanelopoulou, F., Nieto-Galán, A., Perdiguero, E., *Popularizing Science and Technology in the European Periphery, 1800-2000* (Ashgate, 2009), pp. 217-35.

ety.[26] The inseparable relation between science and society, which emerges when looking at the entire body of a newspaper, brings almost effortlessly the history of science closer to social and cultural history. Our research has shown that news about science were part and parcel of newspapers' discourse because it was felt that science was inseparable from more general and cultural issues. The introduction of new technologies in the Greek cities, for example, was described in a variety of ways, with positive or negative undertones, critical or laudatory comments, revealing the multiple processes of appropriation of the various technologies and the impossibility of what has in the past been described as an 'automatic transfer' of knowledge and practices from one region to another.[27]

Moreover, the examination of the various ways in which science entered the Greek daily press can bring the history of science closer to political history, especially since at the period under examination science and technology were increasingly becoming part of the discourse and rhetoric concerning the formation of Greece's national identity. Research on two Barcelonan newspapers has similarly pointed to the entrenchment of science in their political discourse, which led to the formation of different images of science according to the different social groups addressed.[28] Going back to the Greek case, we might further the political argument by asking what do newspapers tell us about perceptions of the country's position between the West and the East? What do they tell us about perceptions of its peripheral position compared to other European countries, and at the same time its aspirations for an increasingly important position in the Balkans? In a period characterized by an irredentist ideology and territorial claims, news about the expansion of the national railway, technical descriptions of military equipment and discussions about possible uses of airplanes in warfare placed next to political articles on the Macedonian Question cannot pass unnoticed. To give a less explicit example, in 1905, a journalist, who had visited Berlin and saw the efficiency of the electric tram, criticised the decision of the Greek government to introduce trams of an older technology. His concluding remark was that Greece got always what was "bon pour l' Orient".[29] This remark implied both the ambiguous way in which Europeans but also Greek journalists saw the place of Greece lying somewhere between the West and the East.

26 Mergoupi-Savaidou E., Papanelopoulou F. and Tzokas S , op. cit. (note 12).

27 Τζόκας, Σ., 'Ο επιστήμονας μηχανικός στη δημόσια σφαίρα και η διαμόρφωση της κουλτούρας του έλληνα μηχανικού. Η περίπτωση του Ηλία Ι. Αγγελόπουλου (1859-1932)' [Scientist-engineer in the public sphere and the configuration of the culture of the Greek engineer. The case of Elias J. Angelopoulos (1859-1932), in Assimakopoulos M. et al., *Proceedings. 170 years of National Technical University of Athens: "Engineers and Technology in Greece"*, National Technical University of Athens, (Athens, 4-5 March 2009), [forthcoming 2010].

28 Gonzalez-Silva M. and Herran N, op.cit. (note 24a).

29 Ανώνυμος [Anonymous], (1905, 10 December), 'Εδώ κι Εκεί: Από το Βερολίνο' [Here and There: From Berlin], *Skrip,* p. 1.

Newspapers and the public opinion

One of the main research fields of media studies is the examination of the double nature of newspapers both as instruments of influence and expression of public opinion. Based on our research on two Athenian newspapers during the first decade of the 20th century, we have tried to understand this double nature by taking into account the hegemonic role of journalistic discourse in the public sphere.

Within the social and political context of the period, and without a clear definition of what constitutes public opinion, researchers attempted to approach the concept considering it to be the result of a wider historical, political, social and psychological procedure.[30] Often, 'public opinion' was referred to as a criterion for the understanding of certain (public) views expressed by specific social groups with specific objectives and which were addressed to less privileged groups through the mediation of the daily press.[31] In this context, journalistic discourse was the main regulator of the way in which 'public opinion' was expressed and integrated in the public sphere.

The printed media, and especially the daily national press played a decisive role in the constitution of different social groups as reading groups (audiences), in the organisation of their culture and the emergence of public opinion in the communication scene of the beginning of the 20th century. During this period, in Greece, we observe the establishment of the 'daily Athenian opinion press', which addressed the whole population of the country and which went hand in hand with the development of the socioeconomic, political and technological structures of the country.[32] The evocation of the 'public opinion' by Greek journalists took place mainly in political articles, dealing with pressing national issues, such as the Cretan, Macedonian and Eastern Questions. Writing about, or criticising, what the 'public opinion' thought of local or national affairs became, to a certain extent, an instrument of political pressure, employed by journalists according to their political alliances and beliefs.[33]

In particular, on what concerned science and technology, Greek journalists did not write about scientific theories and technical issues only to describe the scientific phenomenon. They also developed a discourse that incorporated the values and ideas associated with the increasingly important role of science and technology for the immediate prospects of Greek society. This discourse blended both optimism about the emergence of a technoscientific society as well as criticism about the changes occurred. The press was not always supporting modernity, and journalists took the opportunity to comment and criticize the notion of progress. The everyday struggle of Greek society to adjust to the transformation of their cities was made evident in

30 For a genealogy of the concept of 'public opinion' see Habermas, J., *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society* (Cambridge, 1962/1989); Childs, H.L., *Public Opinion. Nature, Formation and Role* (Princeton, 1965); Noelle-Neumann, E., *The Spiral of Silence: Public Opinion, Our Social Skin,* (Chicago, 1984/1993).

31 The daily press was the first media of mass communication that contributed to the development of public opinion. See Price, V., *Public Opinion*, op.cit. (note 21).

32 Μπαλτά, Ν., *Η εξέλιξη της ειδησεογραφίας στις ελληνικές εφημερίδες τον 19ο αιώνα [The evolution of newswriting in Greek newspapers in the 19th century]*, In L. Droulia (ed.), Institut de Recherches Néohelléniques. Fondation Nationale de la Recherche Scientifique, (Athènes 2005), p. 65; Μπασάντης, *The Daily Press…* op.cit. (note 15), p. 53- 54.

33 See for example: Παπαντωνίου, Ζ. [Papantoniou, Z.], (1908, 2 October), 'Παρισινά Γράμματα: Η Κοινή Γνώμη' [Letters from Paris: Public Opinion], *Embros,* p.1-2

discussions about the impact of the introduction of new technologies in urban centres.[34] The extent to which these articles really expressed public opinion on the latest advances of science and technology is, of course, difficult to gauge.

Newspapers and the public image(s) of science

At the turn of the 20th century, science and technology appeared as major agents of social progress, which transformed urban spaces, changed people's daily habits and improved the standards of living. Although Greek newspapers wrote broadly about science and technology, it seems that they didn't emphasize the utility of scientific knowledge and practice for the benefits of individuals. Rather, they referred to the useful character of science for society as a whole. Even though newspapers did not incite their readers to participate in scientific enterprise for self-improvement, they held a mediating position between the scientific community and the wide public and contributed to the social legitimation of science. It is important to keep in mind that science was in the hands of a social elite, and access to science as to any kind of knowledge at that period was synonymous to social recognition.[35] By conveying to the public a variety of news on science and technology, their impact to society, as well as the participation of scientists in the public dialogue, newspapers familiarised the public with institutional aspects of scientific activity and therefore contributed in the shaping of a public image for science. Of course it is difficult to affirm with certainty whether, and to what extent, discussions on science in the newspapers impelled a part of the Greek public to engage with science, either on a professional or an amateur level.

Newspapers often published articles on the activities of the international scientific community, such as on-going research, conferences, publications, controversies etc. These articles showed how science was produced and practiced by specific professional groups in specific institutional spaces, such as universities, laboratories and research centres. They described the experimental work conducted in laboratories, the equipment and experimental apparatus used, as well as the methods and techniques developed by new scientific fields. Journalists reported also the emergence of new scientific disciplines, while an important number of articles dealt with announcements from various international academies of science, and the events taking place at international conferences. News on special periodical editions on science provided a picture of how members of a scientific community communicated with each other and underlined to the public the importance of the constitution of a scientific community as one of the major legitimating mechanisms of scientific activity.

Journalists contributed also to the creation of the image of the scientist as an individual. Especially in relation to current inventions, newspapers presented scientists as 'geniuses' and moral persons working for the good of science and subsequently the good of society as a whole. This particular public image of scientists captured the curiosity of the public who requested more information about the 'saviours' and heroes of modern society. Newspapers had a dual

34 Mergoupi-Savaidou, Papanelopoulou, Tzokas, op. cit. (note 12).

35 Τσουκαλάς, Κ., *Εξάρτηση και Αναπαραγωγή: Ο κοινωνικός ρόλος των εκπαιδευτικών μηχανισμών στην Ελλάδα [Dependence and Reproduction: The social role of educational mechanisms in Greece]* (Αθήνα, 1981); Αντωνίου, Γ. *Οι Έλληνες μηχανικοί. Θεσμοί και ιδέες 1900-1940 [Greek engineers. Institutions and Ideas 1900-1940]* (Αθήνα, 2006), p.119-120.

function in shaping this image and, at the same time, responding to the public's eagerness to learn more about scientists with the publication of biographies, interviews and photographs of scientists and inventors. Biographies offered a human-interest story with details from scientists' private lives, interviews created an illusion of intimacy with scientists, whereas illustrations provided a visual experience of what scientists looked like. In this way, newspapers apart from rendering scientists public figures, helped to personalize what was 'otherwise thought as the impersonal scientific process'.[36]

In articles dealing with local news and affairs, such as the observation of strange or unexpected natural phenomena or the introduction of new technologies in urban spaces, journalists sought, commented or criticised the opinion of local scientists and engineers. It was mainly through these kinds of news material that newspapers created the profile of the 'local expert', as well as the profile of specific scientists and engineers as 'public figures' in the local society. The way in which newspapers treated the profile of scientific experts gave the impression that these individuals belonged to a social elite, since most of them were related to the University, which was an institution that provided an outstanding social status. Of course, the relation between newspapers, society and scientific community was more dialectic. On the one hand, newspapers *created* the profile of expert, since they could influence public opinion, while on the other hand, they *reflected* the social status of the expert and his obligations towards society, since they were also supposed to 'impress reality'.[37]

Newspaper articles presented science as an exclusive enterprise, restricted to a professional elite made of scientists and engineers. Journalists, on the other hand, had gained access to this exclusive environment, wrote about science and its practitioners, and presented their, often personal, views on scientific issues. On the assumption that the Greek public had little chances to have a direct relationship with the scientific community, journalists were the most common, and widely-read, mediators between science and the public. Between 1900 and 1910, some of the journalists, especially the chronicle writers and the ones with permanent columns, were public figures respected for their broad knowledge on current issues. As mentioned in their own chronicles, there were often approached by 'the man on the street', who sought to learn more about what was written in the paper. In a case of microbe-phobia, for example, created by the affluence of newspaper articles on microbes, the journalist claimed to have calmed-down his fellow citizen by showing the irrationality of his fears.[38] Journalists allowed themselves to provoke their audiences or even to create panic only to dissipate it right after. Was this a way of enhancing their own authority, or was it a way of keeping their readership interested by employing sensational means?

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36 On a similar conclusion about the public images of 'scientists' in British general periodicals see also Broks, P., 'Science, media and culture: British magazines, 1890-1914', *Public Understanding of Science*, 2 (1993), p. 131.

37 See for example: Ανώνυμος [Anonymous], (1909, 13 August) 'Μέγα δημοψήφισμα του Εμπρός, Η σύγκλισης της Βουλής, Τι λέγουν οι επιστήμονες, οι έμποροι, οι βιομήχανοι, ο λαός: Ο λόγος στην Κοινή γνώμη' [The great referendum by Embros, The convocation of the Parliament, What do scientists, merchants, industrialists and the people say: The verdict of Public Opinion], Embros p. 1-2

38 Έψιλον [Epsilon], (1909, 14 September) Εντυπώσεις Αθηναίου: Δάκτυλα και Μικρόβια [Impressions of an Athenian: Fingers and microbes]. *Σκριπ*, p. 1.

In the local context, journalists had to 'trade' with the local scientific community. They usually did not contest the authority of local scientists, except perhaps in the case of controversies. Especially in political controversies in which scientists and engineers were involved, newspapers took sides underlying their role as means of political intervention and propaganda. On what concerned scientific controversies, their stance was somewhat ambiguous. For instance, Greek journalists reported extensively the threat and possible dangers of the passage of Halley's comet in 1910 and used as their sources foreign and local astronomical communities. When the day of the comet's passage was over and the world woke up safe and sound, journalists severely criticised not only the credulity of the lay public, but also the unreliability of the astronomers. However, although they were harsh in their criticism of foreign astronomers, when it came to the local community they showed respect and reproduced uncritically the sober reports of the Athens Observatory.[39]

If we had the means to examine the ways in which journalists were informed about scientific topics, we could perhaps have a clearer understanding of their relationship with the scientific community and their role as mediators between scientists and the public.[40] Did they have a direct relation with the local scientific community, like in the case of interviews, or were there other means of acquiring such knowledge, such as press conferences or news releases from the various scientific institutions? Similarly, more research is also needed in order to examine the way in which newspapers served as a forum for local scientists. In the case of the comet, the frequent interventions of local scientists in the newspapers, gave them the opportunity to portray their science as a 'positive' one, self-fashion themselves as experts and enhance their role in Greek society. Although we are not able to know the exact terms of the 'trade' between journalists and scientists, we can state with some certainty that the presence of the local scientific community in the press was profitable for both sides: on the one hand it gave a forum to scientists, while on the other newspapers gained the credit of a legitimate vehicle of scientific knowledge.

39 Anon., (1910, 7 May) Τα μεθεόρτια του κομήτη. Παραλειπόμενα μιας γενικής αγρυπνίας. Αι ανακοινώσεις του κ. Αιγινήτου. [After the comet. Omissions of a general sleeplessness. The announcements of Mr. Aiginitis]. *Εμπρός*, p. 1.

40 Τζόκας, Σ., op.cit. (note).

Appendix: An Analysis of *Embros* from May 6th, 1910

In the next pages we present a full issue of the newspaper *Embros*, published the day after the passage of Halley's comet. Although the issue is quite exceptional in that it focuses on a single event that had taken place the previous day, we can still discern some characteristics of the 'usual' positioning of science in the Greek daily press since it.[41] *Embros* had published more than 40 articles on Halley's comet, most of which appeared in May 1910.
The general structure of the newspaper remained the same for the entire decade 1900-1910, and was similar to that of other widely circulated newspapers of the time. The front page was dedicated mostly to articles that combined news, commentaries and opinion making. These ranged from political commentaries and analyses, chronicles, science-related articles and small pieces of information collected from the foreign press. The use of a banner, which covered the entire width of the printed area under the title of the newspaper, alerted for breaking news that had just arrived with the telegraph and were analysed in the middle pages. Occasionally there were illustrations, with or without captions, usually related to an article or a news item.

The bulk of the news was placed in the middle pages, and was grouped under headings such as 'News of the day', 'The latest', 'From day to day', 'Last hour', '5 in the morning'. Apart from the distinction between national and international news, there seems to be no particular arrangement of the news-items. These ranged from political, commercial, maritime and social news to information about the stock market, various announcements, advertisements, and serial novels. In general, there were very few articles that can be clearly identified as articles of science popularization. However, issues related to science and technology were spread throughout the newspapers in articles written by different journalists and serving different purposes.

Front page of the daily newspaper *Embros* (May 6th, 1910) a day after the passage of Halley's comet.[42] The banner of the newspaper advertises the latest news on the Cretan Question and the intervention of the politician Eleftherios Venizelos. Similarly the column on the left is on political news on the issue of Himarra. The pictures present the Queen of England and King Edouard, who had died a few days ago. The short article on the upper righthand side is from a translation of an article of the French journalist Cl. Vautel on equality. The two central articles are devoted to Halley's Comet. Both of them are written in a humourous way.

The first one entitled 'The agent/broker'(Ο ΜΕΣΙΤΗΣ) decribes the impact of the news of the comet's passage on the Greek public. The journalist argues that the only victims of the comet are the astronomers themselves, and the 'astronomers of the coffeehouses' who were trying to use a scientific language in order to describe the phenomenon:

> 'I believe that the tail of the comet is the projection of the solar light through the comet's nucleus',

is one of the phrases which the journalist claims to have overheard in an Athenian coffeehouse.

41 For an analysis on news positioning see our article in *Centaurus*.

42 The dates are according to the Julian calendar, which was used in Greece until 1923.

ΕΜΠΡΟΣ

ΗΜΕΡΗΣΙΑ ΕΘΝΙΚΗ ΕΦΗΜΕΡΙΣ

ΤΑ ΝΕΩΤΕΡΑ ΤΟΥ ΚΡΗΤΙΚΟΥ ΖΗΤΗΜΑΤΟΣ

ΚΑΤΗΓΟΡΗΜΑΤΙΚΗ ΔΗΛΩΣΙΣ ΤΟΥ κ. ΒΕΝΙΖΕΛΟΥ ΕΝ ΤΗ ΕΘΝΟΣΥΝΕΛΕΥΣΕΙ

ΤΟ „ΕΜΠΡΟΣ" ΕΧΕΙ ΤΗΝ ΠΡΩΤΗΝ ΚΥΚΛΟΦΟΡΙΑΝ ΕΝ ΕΛΛΑΔΙ ΚΑΙ ΑΝΑΤΟΛΗ

Η ΑΠΑΝΤΗΣΙΣ ΤΗΣ ΧΕΙΜΑΡΡΑΣ

ΙΣΟΤΗΣ

Η ΣΥΝΑΝΤΗΣΙΣ ΤΩΝ ΔΥΟ ΕΡΩΤΕΥΜΕΝΩΝ

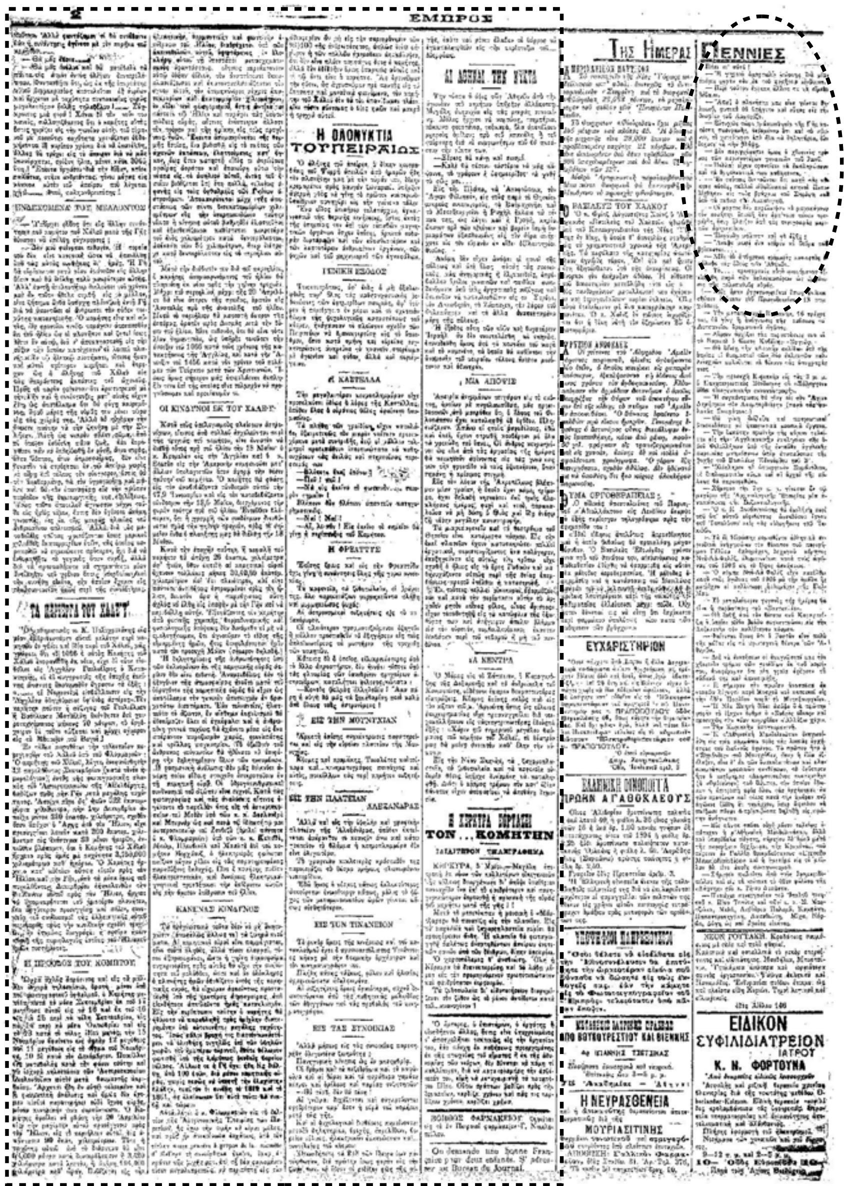
ΗΜΕΡΑ ΖΩΗΡΟΤΑΤΗΣ ΑΝΗΣΥΧΙΑΣ

ΝΥΞ ΣΦΟΔΡΟΤΑΤΗΣ ΑΓΩΝΙΑΣ

Ο ΜΕΣΙΤΗΣ

Front Page

The second article entitled 'The meeting of the two lovers. Day of vivid unrestness. Night of severe anxiety' [Η ΣΥΝΑΝΤΗΣΗ ΤΩΝ ΔΥΟ ΕΡΩΤΕΥΜΕΝΩΝ. ΗΜΕΡΑ ΖΩΗΡΟΤΑΤΗΣ ΑΝΗΣΥΧΙΑΣ. ΝΥΞ ΣΦΟΔΡΟΤΑΤΗΣ ΑΓΩΝΙΑΣ], refers to the way in which the Athenians 'faced' the comet (The' two lovers' refer to the Earth and the comet). Many Athenians spent the night in the hills around Athens in order to observe the phenomenon, some trying to find a way to escape from the imminent danger, others fearing that God's punishment was approaching, and others finding an opportunity for a night-long party. The article goes on describing the opinion of a scientist (a man who is 'more advanced in civilisation and has better scientific means than us'), while in page 2 the article continues with a short interview of the scientist. Another section of the article that occupies the entire first two columns on p.2 is about the past passages of Halley's comet as described in the book of a Greek mathematician. Some factual information concerning the comet, such as the results of spectroscopic analysis as well as it's precise orbit, are also presented so as to disipate any further disquietude .



ΕΜΠΡΟΣ

Η ΟΛΟΝΥΚΤΙΑ ΤΟΥ ΠΕΙΡΑΙΩΣ

ΤΟΝ ... ΚΟΜΗΤΗΝ

ΕΥΧΑΡΙΣΤΗΡΙΟΝ

Η ΝΕΥΡΑΣΘΕΝΕΙΑ

ΠΕΝΝΙΕΣ

ΕΙΔΙΚΟΝ
ΣΥΦΙΛΙΔΙΑΤΡΕΙΟΝ
ΙΑΤΡΟΥ
Κ. Ν. ΦΟΡΤΟΥΝΑ

Page 2

On the second page the first four colums continue with news about the passage of the comet, and describe the night in various places in and around Athens, but also in the island of Corfu (news sent via the telegraph). The last 3 sections at the end of the 4th column are advertisements (one of which is for a liquid tonic for anemia and general tiredness suitable for merchants, scientists and workers…). Column 5 includes some news of the day, such as the building of an american battleship with information about its performance, the trial of an american businessman, and the death of King Edouard due to the medical treatment he was prescribed. The rest of the items are advertisments, the majority of which refer to medical products and therapies. The last column entitled 'Pen-writtings' ['ΠΕΝΝΙΕΣ'] is a compilation of random news items, many of which are devoted to the comet's passage. Although these are isolated sentences, they make perfect sence when one has read the front page articles.

ΕΙΔΗΣΕΙΣ ΤΗΣ ΗΜΕΡΑΣ

ΖΗΤΗΣΑΤΕ

Ε. Α. ΤΟΥΔ

ΛΟΥΤΡΑ ΥΠΑΤΗΣ

ΤΕΛΕΥΤΑΙΑ ΩΡΑ

ΤΑ ΕΣΩΤΕΡΙΚΑ ΖΗΤΗΜΑΤΑ

Η ΛΕΙΤΟΥΡΓΙΑ ΤΩΝ

ΛΟΥΤΡΩΝ ΥΠΑΤΗΣ

ΗΡΞΑΤΟ ΑΠΟ 1 ΜΑΪΟΥ

ΜΠΕΚΙ

ΚΑΙ ΕΚΠΤΩΣΕΙΣ

Page 3

The upper parts of columns 1-4 are also dedicated to Halley's comet. Among the news of the day (ΕΙΔΗΣΕΙΣ ΤΗΣ ΗΜΕΡΑΣ), we find information on a lecture on the North Pole to be given in Rome by the American explorer Robert E. Peary. The North Pole controversy was one of the favorite stories published in the Greek Press. In the middle colums we find advertisemens, some of which are on medical products, while the 5th and 6th columns are entitled 'Last hour' (ΤΕΛΕΥΤΑΙΑ ΩΡΑ) and contain short political news in Greece and abroad.

ΕΜΠΡΟΣ

ΗΜΕΡΟΛΟΓΙΟΝ

5Η ΠΡΩΪΝΗ

Η ΧΘΕΣΙΝΗ ΣΥΝΕΔΡΙΑΣΙΣ ΤΗΣ ΕΘΝΟΣΥΝΕΛΕΥΣΕΩΣ

ΤΟ ΕΘΝΙΚΟΝ ΖΗΤΗΜΑ ΚΑΙ Ο κ. ΒΕΝΙΖΕΛΟΣ

ΚΑΤΗΓΟΡΗΜΑΤΙΚΑΙ ΔΗΛΩΣΕΙΣ ΑΥΤΟΥ

ΙΔΙΑΙΤΕΡΟΝ ΤΗΛΕΓΡΑΦΗΜΑ ΤΟΥ „ΕΜΠΡΟΣ"

Η ΚΡΗΤΗ, Η ΤΟΥΡΚΙΑ ΚΑΙ Η ΕΛΛΑΣ

ΤΟΥΡΚΟΙ ΒΟΥΛΕΥΤΑΙ ΥΠΕΡ ΤΟΥ ΠΟΛΕΜΟΥ

ΑΙ ΑΘΗΝΑΙ ΕΝ ΠΑΝΙΚΩ

ΑΠΟ ΤΟΝ ΚΟΜΗΤΗΝ

Η ΔΙΑΝΥΚΤΕΡΕΥΣΙΣ ΕΙΣ ΤΟ ΥΠΑΙΘΡΟΝ

Ο ΚΟΜΗΤΗΣ ΘΩΠΕΥΩΝ ΤΗΝ ΓΗΝ

ΖΩΜΕΝ ΑΚΟΜΗ!

Η ΤΟΥΡΚΙΚΗ ΒΟΥΛΗ ΦΙΛΟΠΟΛΕΜΟΣ

ΜΝΗΜΟΣΥΝΟΝ

ΓΥΜΝΑΣΙΑ

Page 4

Half of page 4 is also dedicated to the comet's passage. The articles read: 'Athens in Panic. From the Comet. Staying overnight in the countryside' (ΑΙ ΑΘΗΝΑΙ ΕΝ ΠΑΝΙΚΩ. ΑΠΟ ΤΟΝ ΚΟΜΗΤΗΝ. Η ΔΙΑΝΥΧΤΕΡΕΥΣΙΣ ΕΙΣ ΤΟ ΥΠΑΙΘΡΟΝ); 'The comet is looking at the earth. We still live!' (Ο ΚΟΜΗΤΗΣ ΘΩΠΕΥΩΝ ΤΗΝ ΓΗΝ. ΖΩΜΕΝ ΑΚΟΜΗ). Subsections of the second article describe also how the instruments of the Athens observatory were set up, while there is a short interview from the Director of the Observatory, D. Aiginitis, informing that the Athens Observatory was one of the few that were in the right position to observe the passage of the comet. The rest of the page is on the latest political news received by telegraph and announced in the banner of the front page.


ΕΜΠΡΟ 5
Η ΠΡΙΓΚΗΠΙΣΣΑ ΤΗΣ ΕΡΕΙΚΗΣ
ΝΕΟΝ
ΟΛΑ ΤΑ ΕΙΔΗ ΤΑΞΕΙΔΙΟΥ
Θ. ΣΚΟΥΡΛΕΤΗ
Γ. Δ. ΣΤΑΜΠΑΔΟΣ
ΥΦΑΣΜΑΤΑ
ΚΑΣΜΗΡΙΑ
,ΑΝ ΕΜΕΝΑ'
ΜΕ ΜΙΑ ΔΕΚΑΡΑ
ΠΑΝΑΘΗΝΑΙΑ
ΠΑΡΕΛΑΒΟΝ
ΤΖΙΝΗ
78 ΟΔΟΣ ΕΡΜΟΥ 78
ΑΠΟΘΗΚΗ ΔΕΜΑΤΩΝ
ΣΟΚΟΛΑΤΙΝΙΑ & ΦΟΝΤΑΝ
ΦΑΝΕΛΛΑΙ ΕΣΩΒΡΑΚΑ
ΤΑ ΘΑΥΜΑΣΙΩΤΕΡΑ ΤΗΣ ΜΕΣΟΓΕΙΟΥ
ΠΤΩΧΕΥΣΙΣ ΑΝΑΓΚΑΣΤΙΚΗ ΕΚΠΟΙΗΣΙΣ
117—ΟΔΟΣ ΕΡΜΟΥ—117
ΦΤΗΝΕΙΑΙΣ ΑΠΙΣΤΕΥΤΑΙΣ
58—ΣΤΑΔΙΟΥ—58
ΥΓΡΟΝ
ΟΡΦΑΝΟΤΡΟΦΕΙΟΥ
Ν. ΒΑΚΤΑΛΟΠΟΥΛΟΥ
ΝΕΣΤΛΕ
ΓΕΩΡΓ. ΠΑΠΑΖΗΤΗ
ΑΝΕΞΑΡΤΗΤΟΝ ΦΕΡΕΤΡΟΠΟΙΕΙΟΝ
Σ. Κ. ΔΩΡΟΒΙΝΗ
,Η ΠΕΛΟΠΟΝΝΗΣΟΣ'
ΤΑ ΜΕΤΑΞΩΤΑ ΚΑΡΑΣΤΑΜΑΤΗ
11-ΣΤΑΔΙΟΥ-11
ΕΙΝΕ
ΤΕΛΕΙΟΤΕΡΑ, ΣΤΕΡΕΩΤΕΡΑ
ΕΥΘΗΝΟΤΕΡΑ
ΚΑΡΑΣΤΑΜΑΤΗ

Page 5

Page 5 has two serial novels in the first and the last colums, while the middle pages contain advertisements, ranging from underwears, to spas, factories powered with steam, incadescent lamps, medical products etc. It was often the case that advertisements used scientific terms in order to promote their products.

ΣΥΦΙΛΙΔΙΚΑ & ΔΕΡΜΑΤΙΚΑ

ΔΩΡΑ ΧΡΗΣΙΜΑ

Η ΚΟΚΟΤΤΕΣ

ΜΙΚΡΑΙ ΑΓΓΕΛΙΑΙ

ΜΗ ΠΛΑΝΑΣΘΕ

ΣΕΡΓΙΑΔΟΥ

ΤΩΝ ΠΑΡΙΣΙΩΝ

Page 6

The last page of the paper features on the upper left hand side a photograph of the explorer Peary and his family in London. There is no accompanying article, apart from the short news item in page 3 of the lecture Peary was going to give in Rome the following day. However, a frequent reader of the newspaper, would have read previous articles in *Embros* on the North Pole controversy between the explorers R. Peary and F. Cook, published throughout 1908. These news articles played both the role of serial stories and that of displaying science to the public. Similarly the historian can recognise the relevance of this picture *only* aften having been through the entire contents of the newspaper on a daily basis.

The other photographs depict the daughter of the administrator of New Zeland, and the children of the deceased King of England. The Royal families were another favorite subject of the Greek daily Press. The rest of the page is dedicated on serial novels, and advertisements.

What can news about earthquakes, volcanoes and eclipses tell us? Science in the Portuguese press at the beginning of the 20th century*

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Centro Interuniversitário de História das Ciências e da Tecnologia (CIUHCT), Lisboa

About an on-going project, methodological choices and database construction

Popularization of science and technology is an established field within the history of science and technology. In the past years, though, the historiography of science popularization has undergone a crisis. The received view of popular science as a downgraded version of science for lay-consumers does not hold any more. Proposals for critical revisions of the dichotomies built in the characterization of popular science, such as the dichotomy between production and consumption, creativity and passive reception, experts and lay audiences are open for discussion.[1]

So far, contributions to the field have mainly used as primary sources periodicals and books, but have seldom dealt with newspapers. On the other hand, in the national context studies on popularization of science and technology have primarily concentrated on periodicals while newspapers have been used as primary sources for strict historical research works.

* We thank Alice Gago and Marisa Costa for their survey of news and Carlos Alvares for the construction of the database. We thank Conceição Tavares and Pedro Raposo for help in the interpretation of the two cartoons on the eclipse.

1 Newspapers abbreviations used: DA, Diário dos Açores; DN, Diário de Notícias. – Criticisms of the received view constitute a large group of bibliographical references. Especially important for this work are: James A. Secord, "Knowledge in transit" ISIS, 95 (2004), 654-672; Bernadette Bensaude-Vincent, A. Rasmussen, eds., La science populaire dans la presse et l' édition. XIX et XX siècles (Paris: CNRS, 1997); Terry Shinn, Richard Whitley, eds., Expository Science. Forms and Functions of Popularization (Dordrecht: Kluwer, 1995); Roger Cooter, Stephen Pumphrey, "Separate spheres and public spaces: reflections on the history of science popularization and science in popular culture," History of Science 32 (1994), 237-267; Jonatham Topham, "Scientific and the reading of science in early nineteenth-century Britain," Studies in the History and Philosophy of Science, " 31 (2000), 397-430; S. Hilgartner, "The dominant view of popularization: conceptual problems, political issues," Social Studies of Science, 20 (1990), 519-539; G. Cantor, Sally Shuttleworth, eds., Science serialized: representation of the sciences in nineteenth-century periodicals (Cambridge: CUP, 2004). In what relates specifically to the rationale behind the Science and Technology in the European Periphery (STEP) international project as it relates to this work see: Kostas Gavroglu, Manolis Patiniotis, Faidra Papanelopoulou, Ana Simões, Ana Carneiro, Maria Paula Diogo, Jose Ramon Bertomeu-Sánchez, Antonio Garcia Belmar, Agusti Nieto-Galan, "Science and technology in the European periphery. Some historiographical reflections", History of Science 46 (2008), 153-175; Faidra Papanelopoulou, Agusti Nieto-Galan, Enrique Perdiguero, eds., Popularizing science and technology in the European Periphery, 1800-2000 (Oxon: Ashagte, 2009).

The research project *An open window to representations of Science and Technology in the Portuguese Press (1900-1926)*, funded by the Portuguese Research Council (FCT/MCTES),[2] which took off in March with a team of three senior researchers, five junior researchers and two scholarship holders contracted to collect data, aims at analyzing public perceptions of science and technology in a country of the European periphery with a high illiteracy rate during the first decades of the 20th century. It relies on a comparative methodology based on the contrast of news issued in generalist newspapers of different political orientations and geographical provenance and covers a period from the end of the Monarchy to the end of the First Republic. The goal is to assess specific characteristics associated with practices of popularization, including differences between ideological aims, the rhetoric of scientism, daily practices and their outcomes, expectations of editors and publishers and the delineation of (potential or real) profiles of audiences for science and technology in a peripheral country such as Portugal. At a theoretical level, the project aims at reaching a historiographical analysis of the drawbacks of popularization as a historiographical category, rather than a historical one.

This project grew out of the collective attempt to prepare the ground for a comparative study of the views on science and technology as voiced in newspapers in the beginning of the 20th century in different countries of the European periphery, which gave way to the organization of a session in the 5th STEP meeting (Minorca, 2006) in which papers were presented on the Portuguese, Spanish, Greek and Danish cases.[3] Unlike our colleagues, who later published the results of further work in the journal *Centaurus*,[4] the Portuguese group had to wait two more years to launch a full research project to develop the exploratory sample presented at Minorca.

The choice of Newspapers

In Portugal, both the end years of the monarchy and especially the First Republic, used science and technology as part of their political agendas and promoted popularization strategies, at times associated with the adult education movement. However, having in mind the high illiteracy rate of Portugal (around 70% at the turn of the century), which restricts the audience for popularization to an elite, a bottom-up approach seems particularly suitable. Accordingly, the primary sources used are mainly daily generalist newspapers from which perceptions of science and technology can be inferred.

2 The project number identification is PTDC/HCT/68210/2006.

3 Conceição Tavares, Ana Carneiro, Maria Paula Diogo, Ana Simões, "Public image of science and technology in the Portuguese press at the dawn of a new century," 5th STEP meeting Popularisation of Science in the European Periphery,Maó, Minorca, 1-3 June 2006; Conceição Tavares, Ana Carneiro, Maria Paula Diogo, Ana Simões, "A imagem pública das Ciências e da Tecnologia na Imprensa Portuguesa (1900-1901)," Colóquio Internacional A História da Imprensa e a Imprensa na História. O contributo dos Açores, Ponta Delgada, 28 -30 Maio 2009.

4 Faidra Papanelopoulou, P. Kjaergaard, "Making the paper: science and technology in Spanish, Greek and Danish newspapers aroung 1900", Centaurus 51 (2009), 89-96; Matiana Gonzalez-Silva, Nestor Herran, "Ideology, elitism, and social commitment: alternative images of science in two fin de siècle Barcelona newspapers, Centaurus 51 (2009), 97-115; Eirini Mergoupi-Savaidou, Faidra Papanelopoulou, Spyros Tzokas, "The public image(s) of science and technology in the Greek daily press, 1908-1910", Centaurus 51 (2009), 116-142; Casper Andersen, Hans H. Hjermitslev, "Directing public interest: Danish newspaper science, 1900-1903," Centaurus 51 (2009), 143-167.

Newspapers were chosen on the basis of their broad ideological scope and geographical locations.[5] Such are the cases of *Diário de Notícias* (founded in 1865), *Comércio do Porto* (f. 1854) and *Diário dos Açores* (f. 1870). In the beginning of the 20th century, both the Oporto's and Azores' newspapers were part of Portuguese mainstream press, which was politically engaged in a double sense, either by aligning itself with a particular political party, or by making politics its main theme: the Oporto newspaper was prestigious, had a wide circulation and showed republican leanings; the islander newspaper represented a sector of the monarchical intelligentsia linked to the *Partido Progressista* (Progressive Party). On the contrary, the capital city newspaper took a neutral stance from the political point of view as a result of its ideological commitment to a new descriptive trend in journalism, by counteracting a former style based on interpretative news (opinion news). It assumed itself as a popular newspaper, in which political neutrality combined with trivial news. Its main purpose was to eradicate long opinion articles, avoid discussions of political and polemic issues, leaving to the reader the task of forming his own opinion based on factual descriptions of events.


Diario de Noticias

ANNO — 1900

QUARTA FEIRA 14 DE

A guerra na Africa do Sul

TELEGRAMMAS

30.° Anno — 1900 Sexta-feira, 9 de Fevereiro Serie 3.ª — N.° 2:659

Diario dos Açores

Fundador — M. A. Tavares de Rezende

Assignaturas

PONTA DELGADA — S. MIGUEL

Publicações

A REFORMA DO TABELLIONATO

Conclusão

Fig. 1: Frontpages of newspapers Diário de Notícias and Diário dos Açores

Methodologically, the option is a comprehensive survey of the totality of news issued in the three selected newspapers. This option is based on the fact that Portuguese newspapers presented news on science and technology in a random way, according to local and momentary events, and not in a systematic, daily or weekly column.[6] Although this approach is time-consuming, the authors believe that it is the only which affords a reliable analysis, in both quantitative and qualitative terms. By using previous experience, a database was designed, which encompasses the fields as indicated in classification of Fig. 2.

5 For an overview of the history of the Portuguese press see José Tengarrinha, História da Imprensa Periódica Portuguesa (Lisboa: Editorial Caminho, 1989).

6 More information on the project can be accessed at http://chcul.fc.ul.pt/folheando_jornais.htm.

Although the tools for reaching the objectives of this research project are now manageable, in terms of quantitative data, there is little more to present beyond the exploratory survey of Minorca The amount of news has now doubled, but is still around 2,000. By the end of the project, the team expects to have collected around 40,000 news

Preliminary characterization of news

Before going into the object of this article, it is worth going back to the paper presented at the Minorca STEP meeting and briefly summarize both the Portuguese cultural context on the eve of the 20th century and the characteristics of the newspapers to be analyzed here. The data collected so far corroborates the main trends identified in the STEP communication delivered at Minorca. Science and technology were associated with ideas of development and progress, and smoothly articulated with the political agenda of liberalism, as well as with trends informing both monarchical and republican movements in Portugal at the end of the 19th century. News about science and technology appear on a regular basis, including news of local, national and international import.

Different themes emerged as the most significant. Public health, especially infectious diseases with particular emphasis on tuberculosis, was a major issue, reinforced by the participation of the most renowned Portuguese physicians of the time as authors of the news. All these articles have a strong pedagogical dimension, aiming at enlightening the public on their causes and prevention.

In all newspapers technology comes next, with news focusing on electricity-based transports and communications, electrical lighting, leisure technology (photography, film and the phonograph), aviation and military technology. Technology is presented in close association with the ideology of progress, news on international and colonial exhibitions appearing in this context.

Science proper was not a major issue when compared with medicine and technology, but astronomy, especially the 1900 solar eclipse, held a prominent place, and reports on this event were often written in a style bordering the popularization genre. The Azorean newspaper emerges as an exception, by often dealing with questions of meteorology, oceanography, botany and occasionally geology.

Science and technology often appear associated with travels of exploration and scientific mythical personalities. Figures of unquestionable scientific and technical authority and almost saintly profiled are often convened.

In all newspapers, evaluations of the former century in terms of medical, engineering and scientific advancements were published focusing on developments which took place not only around the world, but also in Portugal. The great conquests of science and technology were object of extended news oriented to the construction of a heroic collective memory of humankind.

Science and technology in newspapers - Proposed classificatory scheme

- Identification of Journal
  - Name of Journal
  - Number
  - Year
  - Month
  - Day
  - Week

Title of article
- Main
- Section
- Other

Articles
- Opinion
- News
- Ads
- Dramatization

- Name of author
  - Author's profile
  - Journalist
  - Collaborator
  - Anonymous

- Location of article (page, columns)

Fig. 2: Screen-prints of database and classificatory grid included in the database

The useful character of scientific and technical knowledge, rather than discussions on their cognitive contents, is emphasized. Indeed, both newspapers put considerable emphasis on the utilitarian dimensions of medicine, technology and science in this particular order. The appropriation and dissemination of knowledge was shaped by the need to respond to local social needs with practical relevance.

In this paper, data will be analyzed in a slightly different way, by using as framework the two main characteristics formerly identified as catalysts for scientific news: worldwide events and local relevance. Are these two kinds of news presented in similar or different ways? Are the agendas behind their choice and presentation similar or dissimilar? Are they addressed to the same public or to different audiences? In this part of the paper two instances of popularization addressing natural phenomena will be discussed, one dealing with the 1900 eclipse, a 'hot' topic all over Europe, as seen by the capital newspaper; a set of news on seismology, written in the newspaper published in Azores, an archipelago with a significant volcanic activity.[7]

Earthquakes, volcanoes and weather in the Azorean newspaper

In the early twentieth century, the newspaper *Diario do Açores* (Azores Daily) published articles on science of various lengths and with distinct purposes. From short news on technological novelties produced in foreign countries to issues of public interest such as those on hygiene and public health, the newspaper also addressed scientific questions.

Since the nineteenth century, Azorean naturalists corresponded with foreign colleagues due to the peculiar features of the Azores's fauna and flora, which attracted the attention of distinguished naturalists, usually fascinated by the peculiarities of islands, such as Darwin who exchanged correspondence with a local young naturalist Arruda Furtado (1854-1887). But Azores also captured the interest of experts of other scientific fields, such as oceanography, meteorology and seismology. The association of Afonso Chaves (1857-1926) with Prince Albert of Monaco stands out as most significant as it represents a case in which personal, local, national and international scientific interests coalesced in a successful partnership.[8]

By reflecting the cultural features and interests of local men of science, the *Diário dos Açores* engaged in the publication of news and articles on seismology and volcanology, given the geographical situation and volcanic nature of the islands. An earthquake in Mexico, a submarine volcano observed by a ship somewhere near Belle Isle, or the formation of a new island following a volcanic eruption in Burma, always deserved a few lines. In turn, more or less long articles on seismology and volcanism aimed at acquainting the readers with hypotheses and theories on the causes of these phenomena, and enlist them in the scientific projects and causes of the local intellectual elite. The hope of rendering these natural events predictable

7 S. Miguel, the island where the newspaper was published has three active volcanoes; in 1957, the major eruption of the Capelinho volcano enlarged the Faial island by 24 km2, causing about 300 seismic activities during more than one year.

8 Conceição Tavares, Viagens e diálogos epistolares na construção científica do mundo atlântico. Albert i (1848-1922), Afonso Chaves (1857-1926) e a Meteorologia nos Açores, MSc unplished thesis, FCUL, 2008; to be published in book form as Albert I do Mónaco, Afonso Chaves e a Meteorologia nos Açores. Episódios oitocentistas da construção científica do mundo atlântico (Ponta Delgada: Sociedade Afonso Chaves e CIUHCT, 2009).

and in this way diminish their impact was certainly assumed as being appealing to Azoreans, who live permanently under the threat of earthquakes whose consequences they know too well.

Long articles on seismology and volcanology were often published, usually on page one and in a serial form, by authors — under their own name or a pen- name— of whom little is known so far, or by an anonymous reporter. The approach is often historical as past theories are presented to the readers in a chronological framework, together with the discussion of the latest hypotheses and conflicting theories. Controversy is taken as part and parcel of the construction of scientific knowledge as well as its incomplete nature. The views of philosophers and of more or less renowned local or foreign experts, who were then trying to unveil the causes of earthquakes and volcanoes, are used as sources of authority and legitimation.

In a serial written by Theobaldo Câmara, one of the topics addressed was the origin of the Universe, the Earth's hidden interior, volcanoes and the causes of earthquakes.[9] The Earth's interior is discussed, in particular its temperature and physical state, from the surface to the centre. Regarding volcanoes, a short review is made from the mythological interpretations of antiquity to the views of the American Thomas Sterry Hunt (1826-1892), advocating that between the surface and the centre of the Earth there is an intermediate layer of molten rocks from which lava originates. From his various sources, Câmara concludes that volcanic eruptions seemed to be the result of a struggle between the vapours inside the Earth and huge masses of solidified matter obstructing their passage. The geographical distribution of volcanoes in the vicinity of seas and oceans seemed to corroborate this interpretation, but Stanislas Meunier (1843-1925), the French herald of experimental geology, denied it: he claimed that the Andes and the Abyssinian mountains ridges pointed precisely to the contrary.

Earthquakes were up to then often associated with volcanoes, although they are distinct phenomena and not necessarily linked. Câmara sets out to discuss the causes of earthquakes. He begins with theories ascribing to the Moon, the Sun or other planets the cause of seismic phenomena, then moves to the tectonic theories of Albert Lapparent (1905-1975), and presents a typology of earthquakes based on their possible causes: subterranean collapsing, volcanic and structural. He then proceeds to the theories of the Austrian Eduard Suess (1831-1914) and the American James Dwight Dana (1813–1895), Lapparent, and the Irish Robert Mallet (1810-1881). Their views pointed to the fact that the Atlantic axis, where Azores is located, and the depression of the Great African Lakes were the regions of the globe of highest seismicity. Given the hypothetical status of all these theories, only the methodical and systematic recording of seismological data could lead to sound conclusions about the causes of seismic activity. Câmara reaches this conclusion at the end of this serial, which is telling. Although at this point he does not make explicit the importance of Azores in a network of seismological observatories, the fact that the islands were then part of an international meteorological network reinforces the mutual association of meteorology with seismology. Both were based on recording data by means of instruments, and linked by the same assumption, the need to predict phenomena in order to reduce possible damages.

9 Theobaldo da Câmara, 'Formação do Universo – Kant, Laplace, Faye e Du Ligondés – o interior da terra – teoria dos vulcões – causas dos "sismos" - como se registam os "sismos" – relações entre a Terra e o Sol' I-IV, Diario dos Açores, 4 May, 7 May, 14 may, 24 may, 3 july, 1907

Meanwhile, short news on earthquakes occurred in other parts of the world, notably in the UK, and began to make readers familiar with seismographs. As Mercurio, certainly a pen-name, reports: 'From London, seismographs continue to record violent earthquakes (…).'[10]

It is worth mentioning that short news on seismology published in 1910,[11] also focussed on seismological stations, notably on the fact that nationwide, including the Azores, these stations were required to report any event to the Central Seismological Station Don Luis, in Lisbon; or that the geologists Alfredo Bensaude (1856-1941) and Paul Choffat (1849-1919) members of the committee in charge of outlining the seismological national project required the Observatory of the University of Coimbra to analyse seismograms from the earthquake felt on mainland Portugal, on 23 April 1909.

In this and subsequent serials on this topic the aim is increasingly to reinforce the agenda whose core argument was the need to establish in Portugal an internationally linked seismological network. Surely, the participation of Portuguese seismology in the international scene by means of its own network of seismologic stations was perceived as an element contributing to raising the country's prestige abroad, still suffering the sequels of the trauma inflicted to national pride by the British Ultimatum, in 1890.

A serial by an unknown author focussing on the Seismological Service of Portugal began being published on 1 February 1910, reproducing a lecture delivered by the local expert Afonso Chaves, director of the Azores Meteorological Service. Following the earthquake of 1909, a movement involving the Portuguese Parliament and the press, prompted the government to initiate the process of creating a national seismologic service. To this end a committee was appointed by the Ministry of Public Works composed of the directors of the meteorological observatories of Oporto, Coimbra, Lisbon, and Azores. Afonso Chaves represented the Azores Meteorological Observatory in the committee, which also included the geologists Bensaude and Choffat. A plan and a proposal were outlined, and all were deeply committed to its materialisation.

It was in this capacity that the Swiss geologist Paul Choffat, who served in the Portuguese Geological Survey for more than 40 years, was interviewed about the possibility of predicting earthquakes through the use of seismographs.[12] Choffat's penetrating eyes and vivacious expression, features usually present in descriptions of his persona, are emphasised by the anonymous reporter, undoubtedly to accentuate the authority of his source. Perhaps unexpectedly, Choffat argues unequivocally that, so far, there was not a single instrument capable of predicting earthquakes: seismographs simply record the motion of the ground while earthquakes are occurring, and seismograms are interpreted following the phenomenon.

Surely, with the aim of counterbalancing Choffat's categorical statement, the reporter mentions Atto Maccioni (?-?), who argued that the magneto-electric waves produced by seismic phenomena can be detected by appropriate apparatuses shortly before an earthquake. But in view of Choffat's authoritative statement, the reporter recognised with some dismay that Maccioni's claims required further proof.

10 DA, 19 de Julho, 1907, 19 July.
11 DA, 1 de Fevereiro e 17 de Agosto, 1910.
12 DA, 4 de Fevereiro de 1910.

In the same issue, readers are informed that Choffat had replaced Afonso Chaves in the international conference on seismology, which took place in Zermatt, Switzerland. On his arrival, Choffat was again interviewed, and reiterated his views on the prediction of earthquakes by arguing that seismographs were still unreliable: the proof was that at Zermatt, none of the models competing for a prize met the requirements. Confronted with Choffat's authority, the reporter wondered how one could believe in the claims on earthquakes made by fortune tellers often published in newspapers. However, in the next issues, *Diario dos Açores* will allocate considerable space to extraordinary claims surrounding earthquakes and volcanoes.

Volcanoes could also play a part in utopias of progress — which the newspaper uses to seduce its readers and secure their support — with mankind profiting from natural resources and phenomena, reaching easily the highest standards of living, and even overcoming those then available only to a few fortunate millionaires. In par with synthetic dyestuffs and fabrics that would make women's dresses accessible, the power generated from volcanic eruptions would be used in the workings of civilization.[13]

The association between meteorology and seismology is made more explicit in a serial whose first article refers to an official report dating from 1904,[14] the pretext being a lecture delivered by Chaves at the local Commercial Athenaeum. The unknown author begins by drawing attention to the past links between astronomy and meteorology, but the core argument is the meteorological relevance of Azores in the international scene and the use of various instruments like thermometers, hygrometers and barometers whose role in helping to predict the weather is explained in some detail. In effect, with the establishment of the submarine cable in 1893, linking Ponta Delgada (Azores) to Cascais (near Lisbon), meteorological data from the islands, relevant to the Atlantic routes, was sent by telegraphy to Lisbon and London, and from these cities to Madrid and Paris.

Chaves's lecture is then reported in the next page (p. 2), his main argument being the need to create an institute devoted to seismology, following the example of other countries. The topics addressed by Chaves are listed: methods of weather forecasting; history of the use of telegraphy in communicating weather reports; the situation of meteorology in the most advanced countries, with particular emphasis on the USA; the creation of the Azorean Meteorological Service and the importance of the islands from this point of view; seismology and earthquakes prediction; classification of earthquakes; seismic and a-seismic regions; modern distribution of three seismic regions based on geosynclines; underwater depressions and sea floors; propagation of quakes, seismographs and Maccioni seismic monitor; finally, Azores's seismicity, especially of São Miguel island.

This accurate account on the state of seismology does not exclude fantastic accounts from the newspaper, the article titled 'Earthquakes and the future of Europe'[15] being a fine example of its kind. It is based on the claims of a French geologist whose name, Moreaux,[16] is only mentioned at the end of the article, surely to raise readers' expectations. Total suspense is in order!

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13 Anónimo, DA, 15 Fevereiro de 1910.
14 DA, 13 de Maio 1910.
15 DA, 2 de Julho de 1910, p.1.
16 We know nothing about who Moreaux was.

According to Moreaux, the Iberian Peninsula would become an island, in the future. Great convulsions such as volcanoes and quakes would cause the disappearance of southern France in the Ocean, and Portugal and Spain would be surrounded by the sea. But readers had nothing to fear, as the reporter reassures them that the structure of the Iberian Peninsula and life would be pretty much the same, unlike southern France and the Balearics, which would be swallowed by the Mediterranean.

Despite the bleak prospects, all these terrifying events would also lead to providential results, in the end: with France reduced to a half, the French were then concentrating on the plans to build a canal right through their nation, between the Atlantic and the Mediterranean, which would be far better than resorting to Gibraltar.

Surely, the experience of French entrepreneur-engineers in building canals such as the Suez, in 1866, explains Moreaux's burst of optimism shared by the Azorean newspaper. Despite the loss of part of its territory, it seems that with the providential help of nature Moreaux was giving French engineers the chance to recover from the failure in building the Panamá Canal (1880-1885).

But natural providence would be felt more widely even if disguised in a catastrophe of this magnitude. In Moreaux's account, England would vanish and Germany 's expansionist pretensions would be equally punished: Germany had no choice but to resign to a smaller territory. Russia, in turn, would lose the steppes and Italy, for so long enduring violent earthquakes and volcanic eruptions, would be spared as a kind of compensation.

The future would belong to the Latin race, concluded the anonymous reporter from Moreaux's forecasts. While the British, the Saxons and the Slaves would be left with practically nothing, the Latin world would finally regain its former glory and power, since Portugal, Spain and Italy would remain unaffected by these extraordinary natural events.

The possibility of Moreaux being a *blagueur* is, however, raised by the reporter, but he argues that the French *savant* had based his predictions on scientific data. By comparing Moreaux's with Camille Flammarion's (1842-1925) less radical theories, he ends by reassuring his readers that, in any case, these events would take place in a time span of hundreds of years.

An article signed by Carlos A. Menezes,[17] on the origin of the vegetation of the Atlantic islands, establishes a connection between their flora, climate and volcanic origin. He argues that the islands were spared from the glacial cooling, the descendants of the Tertiary flora remained, and the affinity between these floras and those of the European continent were explained by the prolonged communication between the islands and the continent. Menezes resorts to the hypothesis raised, in 1855, by the Swiss palaeobotanist Oswald Heer (1809-1883), who had collaborated with the Portuguese Geological Survey, about the possible existence of Atlantis, the mythical continent linking Europe, Africa and America, of which the Atlantic islands would be the vestiges. This very hypothesis was to be adopted by the Portuguese geologist Pereira de Sousa (1869-1957), in his seismological studies published in the first decades of the twentieth century.[18]

17 DA, 31 de Agosto de 1910, p.1.
18 Carneiro e Mota, Pereira de Sousa

Azores 's peripherality in relation to mainland Portugal, which in turn is peripheral to the rest of Europe, seems to have awakened a wish of belonging to a brotherhood of nations articulated on the basis of common racial, linguistic, cultural and territorial roots, like Atlantis, and translated into expressions like the Latin race, or the Atlantic/Mediterranean people, which although more abundant in popular accounts of science, also appear in scientific writings. As localism and nationalism were not enough to affirm the Azores and Portugal in the European chessboard, both politically and scientifically, a coalition of Latin countries would have more chances to succeed even if in the realm of utopia. Besides, Nature seemed willing to cooperate again with its providential hand as it had done in the ancient past, when Atlantis existed in its greatest splendor, or when the Romans controlled a vast empire.

The volcanic nature of Azores and its geographical location in the Atlantic made meteorology and seismology appealing to local readers who had firsthand experience of the effects of earthquakes and of the vagaries of the weather. Both sciences relied on the systematic recording of data by instruments, with a twofold purpose: the explanation of causes and the prediction of events. However, the degree of predictability and reliability of instruments was seemingly higher in meteorology than in seismology, but in both sciences the participation in international networks of meteorological and seismological observatories was perceived as crucial, given the widespread and even global impact of geophysical phenomena. In order to make the islanders realize that the advancement of both sciences was of their own interest, various strategies of persuasion were put in place. The popularization of seismology and volcanology in *Diario dos Açores* relied primarily on the scientific authority of the sources, used history as a form of legitimating arguments, and resorted to utopia and predictions of overwhelming natural disasters to persuade readers of the need to engage with the advancement seismology, volcanology and meteorology, as championed by the local elite, eager to win the support of its fellow islanders.

Reverberations of the 1900 solar eclipse as seen through the lenses of the capital newspaper

It is certainly not a coincidence that it was the capital newspaper which gave greater prominence to the 1900 solar eclipse. The solar eclipse was an international astronomical event of great importance, commanding the attention of foreign well-known astronomers, who visited Portugal to take part in the eclipse's observations.[19] The capital newspaper assumed its function of a national, not just local, newspaper, reporting on international events especially relevant to the Portuguese population. The newspaper listed the names of foreign astronomers, including the British Frank W. Dyson, Charles Davidson, G.F. Chambers, William H. Christie, the Germans G. Muller, and E. Jost, as well as Alexander C. Dixon, Augustin Morford, and two American women astronomers G. Sawyer and Trittwitz.[20] Furthermore, it announced special exemptions for them, their luggage and instruments, special train schedules and fares, and

19 Popularization of astronomy, and especially eclipses, have been studied by Pedro Ruiz-Castell, "Popularizing Science", "A 'National Fiesta': total solar eclipses and popularization of science in early twentieth-century," in Josep Simon et al., eds, Beyond Borders. Fresh Perspectives in History of Science (Cambridge: Cambridge Scholars Publishing, 2008), pp.171-8, pp.179-198.

20 DN 7 May 1900. DN 10 May 1900. DN 22 May 1900. DN 23 May 1900.

best observational sites.[21] Foreign astronomers, including teams from the same country, split between the two best observational sites, Ovar and Viseu, and as usual in similar situations specialized on different kinds of observations.[22] The British astronomers from Greenwich, Dyson, Christie and Davidson chose Ovar as their observational site,[23] as well as the German astronomer Jost while Muller went to Viseu.[24] News from weather predictions — thunders and rain — for the day of the eclipse were voiced by the Spanish astronomer Escolastico and given wide publicity.[25]

The solar eclipse became also a genuinely national event, and Portuguese scientific institutions were intimately associated with its observation. Both the National Geographical Society and the Royal Astronomical Observatory of Lisbon took part in tasks attendant to the preparation and reception of astronomical expeditions by providing logistical and scientific support to foreign astronomers, and involving local authorities and the army in the preparations.[26] They were also involved in the organization of expeditions including local astronomers from Lisbon.[27] Astronomers from the Observatory of Coimbra, the oldest active observatory in Portugal, made astrophysical observations in Viseu.[28] A memoir with the results of their observations, including photographs of the different phases of the eclipse and the solar corona was announced.[29] Furthermore, the National Geographical Society organized a 'scientific excursion' to Viseu for those interested,[30] including members and spouses. Members were supposed to cooperate in observations, to follow specific instructions,[31] and preliminary and final results were to be published in the Society's newsletter.[32] Photographic works were especially encouraged due to their scientific and artistic worth.[33]

The scientific excursion was a success involving more than 300 people.[34] Students from the Naval School, Army School and Polytechnic School participated also in expeditions, which held mainly a training character.[35] Teachers and students from a school in central Portugal

21 DN, 1 April 1900: Astronomers were exempted from charges on luggage and instruments. DN, 15 March 1900: The Royal Railroad Company offered 50% discount in the fares.

22 DN 3 May 1900. Indication of observational site in Viseu.

23 DN 17 May 1900.

24 DN 27 May 1900. Special reference to Muller.

25 DN 20 May 1900.

26 DN 13 May 1900. The Astronomical Observatory secured the transmission of time by its pendula to the telegraphic stations of Ovar and Viseu. Personnel of the telegraphic stations were asked to provide help to astronomers if needed.

27 DN 21 May 1900. It is mentioned that Oom, Campos Rodrigues and Teixeira Bastos went to Ovar but further down it is said that the expedition from the Astronomical Observatory went to Serra da Estrela, close to Viseu. DN 15 May 1900. DN 23 May 1900. It is mentioned that Campos Rodrigues, Teixeira Bastos and Guillerme Capelo, from the Observatory of Lisbon were preparing the instruments for observing the eclipse in Serra da Estrela.

28 DN, 3 May 1900. DN, 23 May 1900. DN, 27 May 1900.

29 DN, 2 September 1900. Apparently this memoir was never published.

30 DN, 18 April 1900. List of members of the commission assembled to prepare the scientific excursion. DN, 22 April 1900. Special prices listed for first and second class passengers on the train for first 250 members of the Geographical Society. # DN, 19 April 1900.

31 DN, 26 April 1900. The instructions were taken from the memoir prepared by the Royal Astronomical Observatory, which also prepared a map with the totality path.

32 DN, 19 March 1900.

33 DN, 19 April 1900.

34 DN, 28 May 1900.

35 DN, 29 April 1900. DN 27 May 1900. The team from the Polytechnic School made observations in Viseu.

made several observations, including a registration of the variation of temperature during the eclipse. Their results were published afterward, and highly regarded by the authoritative Frederico Oom, astronomer and vice-director of the Astronomical Observatory.[36]

The solar eclipse became also a national event by enrolling the expertise of national scientists. Members of the scientific commission created for the event were announced in the newspaper.[37] Oom stood out. He wrote extensively on the eclipse both from the scientific and educational point of views, preparing the population for the events to come before, during and right after totality. He published a long memoir, including qualitative descriptions and quantitative calculations of the eclipse, characterization of instruments, and specific instructions for all those who wanted to participate, which followed the pattern of eclipse's memoirs.[38] Five hundred copies were initially printed and the National Geographical Society was granted a special permission to sell them.[39] The parts selected to appear in the newspaper included the characteristics of the eclipse and its progressive phases,[40] mapped its totality path and presented calculations,[41] described the effects it provoked on animals, and called attention to its importance for the observation of the solar corona and prominences.[42]

Although the Lisbon Observatory specialized in positional astronomy, and Oom belonged to such a tradition, the new roles for eclipses as a consequence of the recent transition from positional to physical astronomy were highlighted in the selected parts. His scientific description was couched in poetic terms meant to captivate his broad readership. He certainly knew how to do it as he had long experience of writing popularization texts on astronomy.

Fig. 3: Scientific characterization of the eclipse

36 DN, 12 December 1900.

37 DN, 3 April 1900. The commission included Mariano Cyrillo de Carvalho, professor at the Polytechnic School, Campos Rodrigues, Frederico Oom and Artur Teixeira de Bastos, all three astronomers from the Royal Observatory of Lisbon and José Nunes da Matta, professor at the Naval School.

38 Frederico Oom, O Eclipse solar de 1900 (Lisboa: Imprensa Nacional, 1900).

39 DN, 29 April 1900.

40 DN, 28 April 1900.

41 DN, 25 May 1900.

42 DN, 30 April 1900.

The eclipse also became a national event by enrolling the participation of the population, from the Queen and the consort Prince[43] to uneducated people, all becoming amateur observers of such a rare phenomenon. They were so many that Viseu accommodated 3000 visitors, a number which amounted to 1/3 of its population.[44] Social and cultural events were organized for special guests, from tours to cultural sites to outdoor dinners.[45] The eclipse's national relevance materialized in 38 articles, distributed from 8 March to 12 December, making often the first page of the capital newspaper. Extensive information of the happening, with descriptions of preliminary observations from various places, was included on the two days following the eclipse.[46] Its importance was such that both the eclipse's day and the day after were declared holidays.[47]


rio de Noticias

SABBADO 28 DE ABRIL

O ECLIPSE DO SOL

Fig. 4: Scientific characterization of the eclipse and its phases

43 DN 23 May 1900. DN 24 May 1900. DN 28 May 1900.

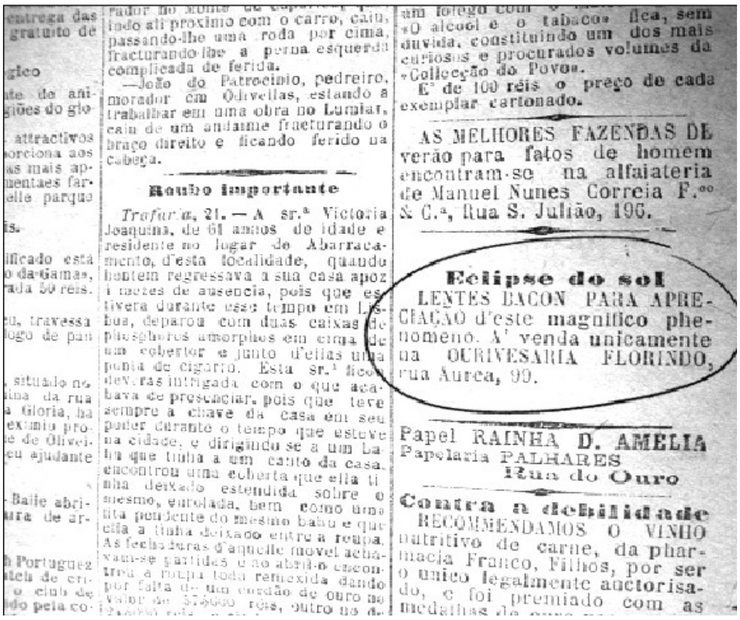
44 DN 28 May 1900.

45 DN 24 April 1900. The mayor of Viseu is preparing visits to the cathedral and an excursion on the eve of 29 May to the mountain of Bussaco to see the sun's rise. DN 3 May 1900. Outdoor dinner. DN 8 May 1900. Special accommodations, meals, resting places arranged by the mayor. DN 27 May 1900. The paintings of the famous school of Grão Vasco will be shown to visitors.

46 DN, 29 May 1900. DN, 30 May 1900.

47 DN, 13 May 1900. DN, 17 May 1900. DN 22 May 1900. DN 23 May 1900.

If the astronomical event was single, it gave way to different extra-scientific uses. An advertisement of German lenses (Bacon lenses) specially fit to follow the eclipse safely through all its phases and sold in a Lisbon shop testifies to its commercial appropriation (Fig. 5).[48]



indo ali proximo com o carro, caiu, passando-lhe uma roda por cima, fracturando-lhe a perna esquerda complicada de ferida.
—João do Patrocinio, pedreiro, morador em Odivellas, estando a trabalhar em uma obra no Lumiar, caiu de um andaime fracturando o braço direito e ficando ferido na cabeça.

Roubo importante

Trafaria, 21. — A sr.ª Victoria Joaquina, de 61 annos de idade e residente no logar do Abarracamento, d'esta localidade, quando hontem regressava à sua casa apoz 4 mezes de ausencia, pois que estivera durante esse tempo em Lisboa, deparou com duas caixas de phosphoros amorphos em cima de um cobertor e junto d'ellas uma ponta de cigarro. Esta sr.ª ficou deveras intrigada com o que acabava de presenciar, pois que teve sempre a chave da casa em seu poder durante o tempo que esteve na cidade, e dirigindo se a um bahu que tinha a um canto da casa, encontrou uma coberta que ella tinha deixado estendida sobre o mesmo, enrolada, bem como uma fita pendente do mesmo bahu e que ella a tinha deixado entre a roupa. As fechaduras d'aquelle movel achavam-se partidas e ao abril-o encontrou a roupa toda remexida dando por falta de um cordão de ouro no valor de 57$000 réis, outro no de...

...fica, sem duvida, constituindo um dos mais curiosos e procurados volumes da «Collecção do Povo».
E' de 100 réis o preço de cada exemplar cartonado.

AS MELHORES FAZENDAS DE verão para fatos de homem encontram-se na alfaiateria de Manuel Nunes Correia F.ºº & C.ª, Rua S. Julião, 196.

Eclipse do sol
LENTES BACON PARA APRECIAÇÃO d'este magnifico phenomeno. A' venda unicamente na OURIVESARIA FLORINDO, rua Aurea, 99.

Papel RAINHA D. AMELIA
Papelaria PALHARES
Rua do Ouro

Contra a debilidade
RECOMMENDAMOS O VINHO nutritivo de carne, da pharmacia Franco, Filhos, por ser o unico legalmente auctorisado, e foi premiado com as medalhas de ouro...

Fig. 5: Commercial advertisement

Its political appropriation gave way to two different cartoons (Fig. 6).

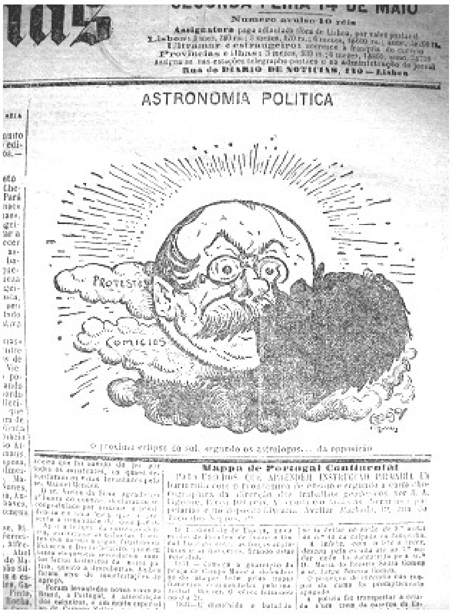


Fig. 6: Political cartoons: political astronomy and international eclipse

48 DN, 24 May 1900.

On the eclipse's day a cartoon dubbed 'International eclipse' depicted two astronomers looking at the face of the Sun which represents the politician Paul Kruger, leader of the Boer resistance against British dominion, and elected President of the Republic of Transvaal for the fourth and last time, in 1898. During the Second Boer War, his position became unstable. By the day of the eclipse, the situation could not be worse.[49] At the national level, the political appropriation of the eclipse by those opposing the government materialized in a revealing cartoon named 'Political Astronomy' (Fig. 6).[50] The sun represents the face of the politician José Luciano de Castro, leader of the Party in power (Partido Progressista). The government was to resign on 25 June, but by 14 May Luciano de Castro was still the commanding Sun, albeit challenged by protests and political rallies (white clouds) and by Ernesto Hintze Ribeiro, a man of the opposition and central figure of the rival party (Partido Regenerador), whose face's contour is symbolized by the big black menacing cloud. He was soon to become Prime-Minister.

By contrasting the coverage of the 1900 eclipse with the 1905 eclipse of 30 August, whose totality path crossed Spain but not Portugal, we realize that they were clearly asymmetrical. In 1905, there were substantially less news, which were mainly concerned with the organization of training expeditions to Spain for students of the Naval School.[51] Seen through the lenses of the capital newspaper we can argue that the series of articles surveyed represent the 1900 eclipse in multiple and complementary facets pointing to its mixed nature. Articles embodied assorted features of organizational leaflets, scientific news, popular texts and cartoons satirizing political events. In turn, the eclipse acquired extra lives. It started as an international scientific event which turned national with both scientific and social implications. It became the occasion for educating the population, for celebrations and partying. Finally, by turning the eclipse's day and the day after into two successive holidays, Portuguese astronomy and astronomers were given extra credit and legitimacy.

49 DN, 28 May 1900. He left Pretoria the day after the eclipse, at first kept in hiding and then left for exile. The interest of Portugal in the Boer War was associated with the construction of railway linking Lourenço Marques, Mozambique, to the Transvaal.

50 DN ,14 May 1900.

51 DN 8 April 1905. DN 21 May 1905. DN 27 June 1905. DN 21 July 1905. An exception is the long article by the naturalist and popularizer J. Bettencourt Ferreira in DN 29 August 1905.

Concluding remarks

In this paper, two different instances of popularization involving the discussion of sporadic natural phenomena with different characteristics were discussed. Earthquakes and volcanoes are natural episodic phenomena whose occurrence was basically unpredictable while eclipses had been for long accurately predictable by astronomers. Earthquakes and volcanoes commanded respect for their frightening consequences and eclipses for their spectacular features. Their impact could not go unnoticed by the population. Their choice for news' topics shaped the ways the two sorts of events were popularized: the unpredictability of the first gave way to sophisticated historical digressions, calm outlines of future projects, and fictional accounts; the eminence of the second turned newspapers into efficient vehicles for enlightening readers on the eclipse's astronomical features and impact, and entreated people to become active participants in the observations.

Furthermore, their choice for news' topics cannot be taken as neutral information on scientific matters of local or national interest. In fact, both were used by the scientific community as legitimizing strategies through the mediation of journalists who acted between them and the masses. On the one hand, they provided the occasion for the affirmation of Portuguese science and scientists both in the national and the international context; on the other, they provided the opportunity to renegotiate the country's situation in the political and scientific geography of nations. In this context, they emphasized the participation of Portugal in an international network of seismologic stations, welcomed foreign astronomers, and fictionalized a situation in which Portugal would occupy a central position as a mediator between a reshaped Europe and the USA. All added up to a reaction to the negative consequences for Portugal of the British Ultimatum (1890) and the Berlin Conference (1895).

Finally, at the historiographical level, the news on the eclipse reveal how popularization of science has to be viewed as a two-way process, in which the population was involved as an active participant, by collaborating in observations which were subsequently incorporated in scientific reports on the eclipse. As instances of popularization of science, eclipse news not only contributed to the affirmation of Portuguese science but also to the affirmation of Portuguese astronomy as part and parcel of the life of the country, counting whenever possible with the active participation of its people.

The case of the Azorean newspaper portrays a distinct situation. The contents and style of the articles were oriented to an educated audience, which was expected to lobby for the interests of the island both in the national and international context, by promoting the participation in a nationwide internationally linked seismological network.

Representations of Radium and Radioactivity in the Spanish Jesuit Magazine *Ibérica*, 1914-1936

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This paper provides a first approach to the history of *Ibérica*, one of the most important science popularisation magazines before the Spanish Civil War. Founded in 1914 by Jesuits based in the *Observatorio del Ebro*, *Ibérica* provided a vision of modern science according to a complex mixture of elitism, utilitarianism and Catholic dogma. In a context marked by belated industrialization, social tension and ideological struggle, *Ibérica*'s creation and development can be understood not only as a vehicle to make visible researches of its host institution, but also as a way to provide an image of Catholicism in tune with the modern world. By focusing its coverage of radioactivity and the radium industry, the article offers indeed some insights about the representations of radioactivity and nuclear physics in the public sphere in the first decades of the twentieth century.

Introduction

The inter-war years were a critical period for scientific research and science popularisation. In a context of increasing support for science through foundations and national research agencies, new relationships between science and the "public opinion" emerged. New modes of scientific popularisation, like professional science journalism, appeared in parallel with the transformation of the press and the appearance of new media such as radio broadcasting. Recent studies, focusing on the United States, have described some of these changes by pointing out the origin of the first news services (News Service of American Chemical Society, 1919), the first scientific news agencies (Science Service, 1921), the first professional associations (National Association of Science Writers 1934), the establishment of specific sections devoted to science in mainstream journals (New York Times Science Notes, 1923) or the expansion of Science Museums in the 1930s. However, a transnational history of scientific journalism is still lacking, and we don't know much about developments in other countries, especially in colonies or semi-industrialised countries of the European periphery.[1]

1 An introduction to the topic can be found at Bensaude-Vincent, Bernadette (1997). "In the name of science". In: Krige, John & Pestre, Dominique, eds., *Science in the Twentieth Century.* Amsterdam: Harwood, pp. 319-338. On the American case, see LaFollette, Marcel C. (1990). *Making science our own. Public images of science 1910-1955*. Chicago: University Press; Ehrhardt, George R. (1993). *Descendants of Prometheus: Popu-*

Spain offers a fertile terrain to explore some of the transformations in the landscape of popularisation of science in the first decades of the twentieth century, and in particular for the analysis of the effects of ideological struggle in the shaping of science journalism.[2] This paper addresses these important questions by focusing on *Ibérica*, a Spanish weekly popularisation magazine edited uninterruptedly between 1914 and 1936 by Jesuits based at the *Observatorio del Ebro* (Ebro Observatory). Despite its important print-run and influence, *Ibérica* has been barely studied by historians of Catalan and Spanish journalism, nor by historians of science and technology. In fact, the only references available are a few pages of Alexandre Galí's mammoth history of Catalan institutions in early 20th century, and two papers commemorating the anniversaries of the journal or its host institution.[3]

Beyond these studies, this paper aims to place *Ibérica* in a context of growing interest on scientific research, taking in consideration the political context, changes in Catalan press and inner transformations of the Society of Jesus educational structure to accommodate science. As the volume of sources is overwhelming (*Ibérica* published more than 30.000 pages in the period under study) and the unavailability of a digitized version of the magazine doesn't allow for systematic computer-assisted searches, my analysis has been restricted to the examination of the magazine's coverage of the science and industry of radioactivity.[4] Despite this limitation, the choice of topic allows for the analysis of relevant issues such as gender bias - noticeable as radioactivity was a field with a high participation of woman researchers-; the public image of industrial science –in relation to the radium industry-, or the treatment of scientific controversies related to the use of radium in medicine or to the use of radioactivity in assessing the age of Earth. The analysis of these elements allow for wide-reaching conclusions regarding the magazine popularization aims and underlying ideology. In particular, I argue that *Ibéric*a was instrumental in providing Jesuit scientists with a shop window for reinforcing their discourse about the compatibility of science and faith. At the same time, I show that *Ibérica* conveyed an underlying elitist, utilitarian and religious ideological agenda, which aimed to play a role in the political struggles about cultural value of science in Spain before the Civil War.

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lar Science Writing in the United States, 1915-1948, Unpublished Ph.D. dissertation, Duke University. A first attempt to provide a more geographically balanced view is Bensaude-Vincent, Bernadette; Rasmussen, Anne, eds. (1997). *La science populaire dans la presse et l'édition. XIXè et XXè siècles*. París : CNRS.

2 On the role of ideology in shaping science news in Spanish newspapers in early 20th century, see González-Silva, Matiana; Herran, Néstor (2009). "Ideology, Elitism and Social Commitment: Alternative Images of Science in Two fin de siècle Barcelona Newspapers". *Centaurus* 51(2): 97-115.

3 Galí, Alexandre (1986). *Historia de les institucions i del moviment cultural a Catalunya, 1900-1936. Llibre XX. Col·laboració de l'església al moviment cultural de Catalunya al segle XX*. Barcelona: Fundació Alexandre Galí, p. 167-8. Pascual Bolufer (1995). "Una historia de 75 años". *Ibérica* 376. Genescà, Maria (2008). "*Ibérica*: Primera Revista de Divulgació científica i tecnológica de l'estat, editada a l'Observatori de l'Ebre (1913-1925)". *Actes d'Història de la Ciència i de la Tècnica* 1(1): 377-386. Genescà's paper wrongly characterises *Ibérica* as the first Spanish popularisation magazine.

4 The choice of radioactivity is also related to my recent involvement in research projects on this topic. Based on the project "Foundations for the History of Physics in Spain in the Tweentieth Century", some results have been published as Herran, Néstor (2008). *Aguas, Semillas y Radiaciones. El Laboratorio De Radiactividad de la Universidad de Madrid, 1904-1929*. Madrid: CSIC. A short version of the project results have also been published in English as Herran, Néstor (2008). "Waters, Seeds and Radiation: Radioactivity Research in Early Twentieth Century Spain". In: Simon, Josep et al., ed. *Beyond Borders: Fresh Perspectives in History of Science*. Newcastle: Cambridge Scholars Publishing, pp. 325-344.

'... raising the esteem for our studies': Origin and aims of *Ibérica*

Thomas F. Glick has argued that, in early twentieth century Spain, a "civil discourse" emerged among Spanish elites to isolate science from ideological struggle in order to promote the modernisation of the country.[5] The crisis following Spanish defeat in the War of Cuba (1898) and the loss of the last transatlantic colonies fostered the emergence of reformist and nationalist intellectual movement called *Regeneracionismo*, aimed to reform Spain to "catch up" culturally, technologically and economically with other Western European nations.[6] A climate favourable to educational reforms and scientific research developed together with the establishment of institutions such as the ministry of public education in 1900, and the *Junta para Ampliación de Estudios e Investigaciones Científicas* (JAE, Board for the Extension of Studies and Scientific Research) in 1907. Directed by liberal scientists and intellectuals akin to the progressive *Institución Libre de Enseñanza* (ILE, Free Institution of Learning), the JAE created an important programme of travel grants, funded museums, laboratories and observatories, and critically contributed to foster scientific research in Spain.[7]

Increasing support for science was not exclusive of liberal or socialist politically-inspired movements, but also of conservatives forces. Despite that hard-line Catholics were initially hostile to the establishment to the JAE, a consensus emerged about the need of appropriating science as a way to portray an image of Catholicism in tune with modern world and to respond to the anticlerical association of religion with superstition and backwardness.[8] This was the underlying message of contemporary Catholic intellectuals like professor Bartolomé Feliu, who encouraged Catholic fellows to "respond science with science", or Rafael Martí y Lázaro, who abrogated for "the need of popularising science with Catholic criteria among workers".[9] Appropriating popularisation of science with the purpose of emphasizing the harmony of religion and science was one of the main objectives of Jesuits, whose missions usu-

5 On the idea of the 'civil discourse' in Spain, see Glick, Thomas F. (1988). *Einstein in Spain. Relativity and the recovery of science*. Princeton: University Press; and Glick, Thomas F. (1993). "Ciencia, política y discurso civil en la España de Alfonso XIII". *Espacio, Tiempo y Forma, Serie V, Historia Contemporánea* 6: 81-98.

6 In the contemporary literature of the history of science, this period has been labelled as the "silver age" of science in Spain. Sánchez Ron, José Manuel (1984). *La Edad de Plata de la física española: la física en la Junta*. Madrid: CSIC. For an historiographical critique of the term, see Ausejo, Elena (2004). "Sobre la Edad de Plata de la Ciencia española: a vueltas con los metales". *Abaco: Revista de cultura y ciencias sociales*, 42: 75-82.

7 On the JAE, see Roca Rosell, Antoni; Sánchez Ron, José Manuel (1988). *La Junta para Ampliación de Estudios e Investigaciones Científicas 80 años después, 1907-1987*. Madrid: CSIC. The archive of the JAE, with graphs and statistics about the more than 3000 grants awarded between 1907 and 1939 and its recipients is online at http://archivojae.edaddeplata.org/jae_app/jaemain.html.

8 After the Spanish Civil War, an ideologically reshaped JAE provided the basis for CSIC, the Francoist board of scientific research. Malet, Antoni (2008) "Las primeras décadas del CSIC: investigación y ciencia para el franquismo". In Romero de Pablos, Ana; Santesmases, María Jesús, eds. *Cien años de política científica en España*. Madrid: Fundación BBVA, pp. 211-256.

9 Speaches of Feliu and Martí are reproduced respectively in pages 203-213 and 214-176 of (1905). *Primer Congreso Hispano-Americano de las Congregaciones Marianas. Crónica, personal, documentos, discursos y memorias*, Barcelona: Tip. Católica. Quoted in Revuelta González, Manuel (2008). *La Compañía de Jesús en la España Contemporánea. Tomo III: Palabra y Fermentos*. Madrid: Universidad Pontificia de Comillas de Madrid, p. 597.

ally organised conferences on scientific issues with the aim of spreading doctrine, projecting a favourable image of missioners as educated men, and impressing working classes, who "come out of the church marvelled by so much knowledge, even if they had understood anything".[10]

In this programme, education played a prominent role. The Society of Jesus, one of the most powerful and influential Catholic congregations in Spain, had established since mid nineteenth century a wide network of primary and secondary schools that provided an elitist, catholic-grounded education for the offspring of economic and political elites against the passivity of the state, which was happy to leave education in such hands. This implied an important growth of the Society, which tripled its membership in the last quarter of the 19th century. In early 20th century, the Society expanded its activities towards the creation of universities such as the *Universidad de Comillas* or the *Universidad Comercial* (Bussiness University) in Deusto and technical schools like the *Instituto Católico de Artes e Industrias* (Catholic Institute of Arts and Industry) in Madrid, or the *Centro Escolar y Mercantil* (Bussiness School) in Valencia. These institutions provided the basis for numerous publications, such as the theological *Razón y Fé* (Faith and Reason, 1901) and *Sal Terrae* (1912), or the economics journals *Estudios de Deusto* (Deusto Studies, 1904) and *Boletín de Estudios Económicos* (Bulletin of Economical Studies).[11]

Spanish Jesuits were credited to provide a solid education in humanities, but their network of schools and colleges were considered by contemporary observers as deficient in relation to the teaching of modern natural sciences. Jesuit's long tradition of involvement in science, which went back to the origin of the Society in the 16th century, had no match in late nineteenth century. In early twentieth century, some members of the Society, mostly based in the United States, used seismology as a way to reinvigorate Jesuit scientific networks, establishing a wide network of observatories,[12] and leading to the creation of the Seismological Service in 1911 and the Jesuit Seismological Association in 1925. In Spain, a similar pattern emerged, with Jesuits founding research institutions like the *Observatorio de la Cartuja* (Cartuja Observatory) in Granada in 1902.[13] A similar institution, the *Observatorio del Ebro*, was founded in 1905 in Southern Catalonia, together with a seminar (the "Colegio Máximo") and a technical school and laboratory of biology and chemistry. In 1926, this institution was transferred to Barcelona, becoming the *Instituto Químico de Sarrià* (IQS, Sarrià Chemical Institute), one of the most dynamical and industrially oriented technical schools in Spain.

10 Aims of the conferences are described in the mission reports published in 1900 as *Cartas Edificantes de la Asistencia en España* tome 1, vol. 1, p. 95-96. Quoted in Revuelta, *La Compañía de Jesús..*, p. 210.

11 On Spanish Jesuit publications in the 20th century, see Sanz de Diego, Rafael María (1998). "Una aportación regeneracionista de los jesuitas españoles: la revista *Razón y Fé*, 1901". *Anuario Filosófico* 31: 147-177. A more critical view, which stresses the propaganda aspect of these publications, is Oskam, Jeroen (1995). "Los intelectuales increyentes y el nacional-jesuitismo". *Cuadernos Interdisciplinarios de Estudios Literarios* 6(1): 79-88.

12 Geschwind, Carl-Henry (1998). "Embracing Science and Research: Early Twentieth-Century Jesuits and Seismology in the United States". *Isis* 89(1): 27-49.

13 The Observatory of Cartuja was devoted to astronomical, meteorological and seismic observations, and was established in the aftermath of an important earthquake near Granada in 1884, which caused more than 800 causalities. On its history, see Espinar, Manuel et al., eds. (2003). *Historia del Observatorio de Cartuja, 1902-2002. Nuevas investigaciones*. Granada: Universidad de Granada.

The establishment of scientific facilities in Tortosa can be understood as a way to increasing the scientific profile of the Society of Jesus by focusing on topics attracting popular appreciation and interest: Chemistry, for its recognised utility and the importance of chemical industry in Catalonia; astronomy, for its long-standing popularity reinforced by the total eclipses of 1900 and 1905 in Spain;[14] and seismology, because it fitted well into the network of Jesuit seismological stations and combined a neutral profile -being remote of controversial topics like evolution- with utilitarian value -predicting earthquakes, weather forecast. The election of the emplacement -Tortosa being a conservative city about six hours by train from Barcelona- can be related to the desire to provide some isolation from the uneasy atmosphere of early twentieth century Barcelona. The industrialization had led to period of social unrest, which had its peak in 1909 'Tragic Week', a revolt of working classes against forced conscription and social injustice that was bloodily crushed by the army. Indeed, another reason the presence of the Episcopal site and the existence of a local scientific community led by José Joaquín Landerer (1841-1922), a wealthy amateur naturalist based at Tortosa who had made important contributions in astronomy, paleontology and meteorology. Landerer, a Catholic intellectual, was very close to Jesuits, and bequeathed his fortune to the observatory after his death in the late 1920s.[15]

The establishment of the *Observatorio del Ebro* was led by Ricard Cirera, a Jesuit who had previously worked in Manila Observatory and had conducted the first geomagnetic survey of the Philippines.[16] After returning to Europe, Cirera became acquainted with members of the Catalan bourgeoisie, getting important donations by the heirs of the Catalan banker and philanthropist Pau Gil, who paid for the observatory buildings, and other philanthropists, who paid for instruments. In the negotiations about the establishment of the Observatory, it was instrumental the wave of interest on astronomy motivated by the total solar eclipse of 1905, whose totality track diagonally crossed the Iberian peninsula. The observatory was inaugurated and blessed in September 1904, and one year later it was fully prepared to host an international delegation of seventy astronomers –many of them Jesuits- for the observation of the eclipse.

14 On the public image of 1900 and 1905 eclipses in Spain, see Ruiz-Castell, Pedro (2008). "A 'national fiesta': Total solar eclipses and popularization of astronomy in early twentieth-century Spain". In: Simon, Josep et al., *Beyond Borders: Fresh Perspectives in History of Science*. Newcastle: Cambridge Scholars Publishing, pp. 179–198. On the history of astronomy in early 20th century Spain (including an updated approach to the creation of the Ebro Observatory), see Ruiz-Castell, Pedro (2008). *Astronomy and Astrophysics in Spain (1850-1914)*. Newcastle: Cambridge Scholars Publishing. See also Nieto-Galan, Agustí (2009) "'… not fundamental in a state of full civilization': The Sociedad Astronómica de Barcelona (1910-1921) and its Popularization Programme". Annals of Science 66(4): 497-528.

15 Correspondent of Flammarion, the Abbé Moignó, and the director of the Paris Observatory Pierre Janssen, Landerer devoted much effort to science popularising, publishing in magazines like the French *Les Mondes* or the Spanish *La Ilustración Española y Americana*, or *Crónica Cientifica*. Interestingly, his bequest was invested in the establishment of a new library, a museum devoted to astrophysics and a photographical archive in the Ebro Observatory. On Landerer, see Gonzalo, Rodolfo; Navarro, Víctor (1995). "Josep Joaquim Landerer i Climent (1841-1922). La recerca fora del mon acadèmic: astronomia i geologia". In: *Ciència i Técnica als Paisos Catalans: una aproximació biogràfica*. Barcelona: Fundació Catalana per la Recerca. 459-492.

16 Hagiographies of Cirera and other Jesuits are available at O'Neill, Charles E.; Domínguez, Joaquín María (2001). *Diccionario histórico de la compañía de Jesús*. Madrid: Universidad Pontificia Comillas.

Since its inception, the *Observatorio del Ebro* integrated in the wide observatories devoted to meteorology, astronomy and geophysics. The observatory research focused on solar activity, establishing a long term research project to study the influence of solar activity in climate, being the results currently published in a monthly bulletin, whose exchange links with other international periodicals helped to build an important library. This wealth of information provided the basis of *Ibérica: el progreso de de las ciencias y de sus aplicaciones*, which would be based on a selection of relevant pieces of scientific information collected among this material. At the same time, it would help to publicize the scientific results of the Observatory and other Jesuit institutions, adding visibility and raising support both to the Observatory and the Society of Jesus. Cirera's presentation of the journal is quite transparent about it:

> It would be very convenient […] that, without interrupting the publication of our Bulletin, we could also address our message to the public by popularising the ideas enclosed in it. On the one hand, this would raise the esteem for our studies and increase the number of enthusiasts about research. On the other, it would contribute to the transformation of this admiration and sympathy into wide support.[17]

Ibérica was launched in January 1914, its name being reminiscent of the Latin name for the Ebro (Iber). Despite this apparent localism, the journal can be considered more as a collective endeavour of the Society, as it counted with regular collaboration of Jesuits working in other institutions in Spain, specially Madrid's Catholic Institute of Arts and Industries. *Ibérica* subtitle "*El progreso de las ciencias y sus aplicaciones* (Progress of science and its applications)" not only but also recalled the French science magazine *Cosmos, Revue des sciences et de leurs applications*, founded by the Abbé Moigno in 1852 and that was being published at the moment by the Catholic publishing house "La Maison de la Bonne Presse".

Cirera directed the magazine from 1913 until 1917, a period in which Spanish press suffered from the extraordinary rise of the cost paper (prices increasing by about 80% in the period) because of World War I and the practical monopoly by Spanish paper manufacturer La Papelera Española.[18] *Ibérica* was unaffected by this crisis because of the wealth of the Society of Jesus. By 1917, when José María Albiñana become its new director, the magazine weekly issued 16 pages of good quality scientific popularisation, with illustrations, and sold at affordable prices. Subscription for one year amounted to 10 pesetas in the normal paper issue, while the luxury, *papier couché* issue, cost 20 pesetas/year.[19]

How did *Ibérica* accommodate in the landscape of Spanish science popularisation? The inspection of library catalogues and contemporary statistical surveys reveals the existence of an active market for science popularization in the first third of twentieth century Spain. In Catalonia, for example, there was an important tradition of popular science publications, which the anarchist movement appropriated in some extent to create magazines like *La Revista Blanca*, a journal devoted to "sociology, science and the arts" and based on the model of its French counterpart *La Revue Blanche*. This editorial venture, established by Juan Mont-

17 Quoted in Galí (1986), pp. 167-9.

18 The crisis affected especially socialist and republican newspapers, which renounced to state loans.

19 This can also be considered a proof of the editor's will to approach educated sectors of the working class. At the moment, subscription of the cheap edition amounted to a bit more than one day of salary of a manual worker. Subscription to other contemporary science illustrated popularization magazines, like *Alrededor del Mundo*, was in the same range of prices.

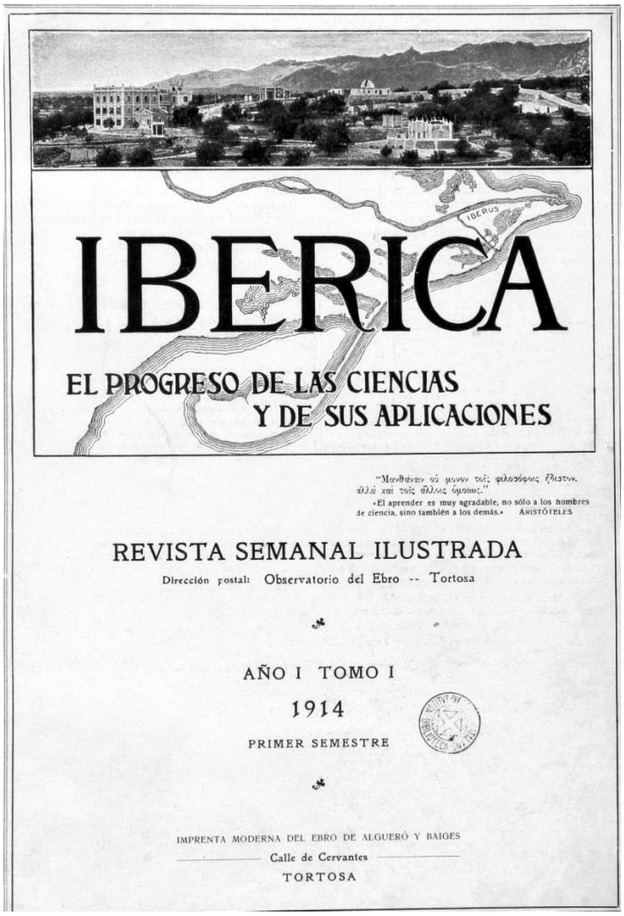

Fig. 1. The first issue of Ibérica, January 1914. On the top, a picture of the Observatorio del Ebro

seny in 1898 (alias Federico Urales) was successful: with a circulation of 8000 journals a week, mostly sold in Valencia, Catalonia and y Andalusia, *La Revista Blanca* enjoyed the appreciation of both intellectual circles as well as that of worker's.[20] However, political interference terminated the project in 1905, and it not reappeared until 1923. In this second epoch, *La Revista Blanca* enjoyed a sustained growth, attaining a circulation of 40,000 by 1927. A year before, the first science popularisation magazine written in Catalan, *Ciència* (1926-1933), was inaugurated in Barcelona.[21] Other commercially-based magazines like *El Mundo Científico* -with reached a circulation of 10,000 by 1920- were widely read.[22] In Madrid, magazines like *Alrededor del mundo* (1899-1930) or *Por esos Mundos* (1900-1920) also seem to enjoy high circulation. At the same time, the 1910s and 1920s many newspapers in Madrid

20 Seoane, María Cruz; Sáiz, María Dolores (1997). *Historia del periodismo español. Vol. 3. El siglo XX.* Madrid: Alianza Universidad, p. 155-6.

21 On the magazine *Ciència*, see March Noguera, Joan (2002). "La revista Ciència (1926-1933), primera revista de ciències i de tècnica en català". In: Batlló, Josep et al., eds, *Actes de la VI Trobada d'Història de la Ciència i de la Tècnica*. En Barcelona: SCHCT, pp. 377-386.

22 Data on circulation of journals and newspapers comes from the three comprehensive surveys made by the Spanish government about in 1913, 1920 and 1927. References are: Ministerio de Instrucción pública y bellas artes (1921). *Estadística de la prensa periódica de España (referida al 1 de febrero de 1920)*. Madrid: Talleres del Instituto Geográfico y Estadístico. Ministerio de Trabajo y previsión (1930). *Estadística de la prensa periódica de España (referida al 31 de diciembre de 1927)*. Madrid: Imprenta Hijos de M.G. Hernández.

and Barcelona included sections devoted to science.[23] In this extent, *Ibérica* cannot be considered as an isolated venture, but it accommodated into a very dynamic scenario of expanding science journalism fueled –as Xavier Roqué as argued- by the need of media to gain legitimacy by establishing links with a science gifted with an unbound power for social transformation, which also needed the support of the state and of the masses.[24]

In 1925, two years after Primo de Rivera *coup d'état*, *Ibérica* editorial office was transferred to Barcelona, occupying a new building near the city council hall and the telephone company headquarters. The new headquarters housed a new brand press, a luxurious library and a conference's room, designed to become a cultural centre in the city. In its new location *Ibérica* reached a circulation of 10,000 by 1927, holding the 27th position in number of sales among 373 periodicals edited in Barcelona, and the 16th if we exclude newspapers from the account.[25] The advent of the Second Spanish Republic in 1931 led to a sudden shift in the situation. The new Constitution included an article dissolving religious orders and limiting their educational activities. In 1934, a government decree allowed for dissolution of the Society of Jesus and the confiscation of its properties, with the exception of the University of Comillas –which was property of the Vatican- and the Ebro Observatory, which was defended by the Barcelona Academy of Sciences and the new, left-leaning, Catalan government.[26] As a result, *Ibérica*'s activities were practically unaffected. The journal continued editing under the direction of the Argentinean Jesuit A. F. Linari, who give more space to right wing conservatives to express polemic opinions on political subjects. An example of this is the reproduction of discourses by Jesuit physicist José Agustín Pérez del Pulgar, who commented on professional education:

> We do not need intelligence, capacity and energy […] We do not need men able to organise and lead, but men able to be managed and participate spontaneously and productively in a organization […] there is not soul strong enough able to animate and fortify an organism whose cells have all their own and independent life.[27]

Or an anonymous commentator of Arthur Keith famous article "Should Science Take a Holiday?", commenting on the Bishop of Ripon speech before the British Association for the Advancement of Science, in which he called for a moratorium of scientific research. In the same vein than its American counterpart, the article in *Ibérica* argued against it and compared its effects to the supposed effects of the Bolshevik revolution in the Soviet Union:

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23 In Barcelona, the most conspicuous example was *La Vanguardia*, who had a regular column written by astronomer José Comas y Solá. In Madrid, *El Sol* and other newspapers featured science and technology supplements. On Comas Solà, see Roca Rosell, Antoni, ed. (2004). *Josep Comas Solà: astrònom i divulgador*. Barcelona: Ajuntament de Barcelona. Cebrian has studied his popularisation work in La Vanguardia from 1901 until 1926, showing than in this period he published around 600 newspaper articles. Cebrian, Ignasi (2002). "Josep comas i sold: divugador cientifico". *Quark* 26: 82–91.

24 Roqué, Xavier (2006). "Einstein i la Premsa. La construcció d'una icona científica contemporània". *Mètode* 48: 24-30.

25 Ibid. In the 1927 survey we find four scientific-based publications with a circulation of more than 2000 per issue: a radio magazine called *El radiooyente* (33.000); a journal devoted to the advancement of chemical industry, *Química e Industria* (2800); and two electricity magazines, *Electricidad* (4000) and *Electricidad y mecánica* (2000).

26 The confiscation process was opposed in several news in *Ibérica*, 917 (27 February 1932): 130-2, and *Ibérica* 923 (9 April 1932): 226.

27 Aznar, Severino (1932). "El padre José Pérez del Pulgar y la enseñanza profesional". *Ibérica* 923: 227. Perez del Pulgar was the director of the Jesuit *Instituto Católico de Artes e Industrias*.

> The worst disaster caused by bolshevism [to Russia] is the wave of ignorance engulfing this misfortunate country, which has been deprived in the last thirteen years of any kind of serious instruction, suffering the destruction of laboratories, the dispossession of its universities, and the misery of its wise man.[28]

The Jesuit elitism and support of monarchy and dictatorship made of Jesuits clear targets for the most combative elements of the working class. With the outbreak of the Civil War, *Ibérica*'s offices were taken by anarchist activists, the publication was suspended and most collaborators went to exile. The publication was not re-established until January 1945. Jesuit Ignacio Puig, who had been exiled in Argentina during the war, took directorship, but *Ibérica* never recovered the influence and sales of the interwar period, beginning a steady decline which accelerated after Puig's decease in 1961. The magazine languished until its closure in 2004.

Appropriating science: radioactivity in *Ibérica*

By the time *Ibérica* was launched, radioactivity had been going on for more than a decade. Research carried on by the Curies, Rutherford and other radioactivists had revealed new elements and established genealogic relations, challenging the previous views on the nature of chemical elements, providing a new perspective of the structure of matter and endowing science with new tools to establish the age of Earth. At the same time, its medical and industrial applications gave rise to the industry of radioactive elements, with radium becoming by 1910s the most coveted and expensive substance in the world. [29] The period under study (1914-1936) was marked by the expansion of radium industry and an important increase of public interest on radioactivity in parallel to the contemporary growth of scientific journalism. As a result, radioactivity enjoyed a sustained presence of radioactivity in the public sphere, which can be ascertained by looking at the number of articles related to radium in the English newspaper *The Times*. As shown in figure 1, the subject was increasingly popular since 1900 and, after the disruption caused by World War 1, references to radium went beyond pre-war levels.

In the interwar period, radioactivity also experienced important scientific developments, such as the establishment of the isotope concept, the development of radioactive dating or the emergence of nuclear physics. On the other hand, safety issues began to be acknowledged after the case of women affected by cancer in radium dial painting factories (late 1920s), the death of workers trained at Marie Curie laboratory and active in the French radium industry because of exposure to radiation (1920s-1930s), or the Byers case (early 1930s), a scandal arising from the death of millionaire Eben M. Byers in 1932 after regularly drinking the radioactive potion "Radithor".[30] How was radioactivity depicted in *Ibérica*? By analysing news

28 "¡Si los sabios se tomasen diez años de vacaciones!". *Ibérica* 862 (24 January 1931): 63-4.

29 According to Lawrence Badash, by early 1920s radioactivity was victim of its "suicidal success". Having characterised all radioactive elements, radioactivity's main principles, it devoted exclusively to refine existing techniques, and produced no significant innovation. His analysis, however, doesn't take into account the industrial side of radioactivity, nor its medical applications. Badash, Lawrence (1979). *Radioactivity in America. Growth and Decay of a Science*. Baltimore: Johns Hopkins University Press.

30 For a general perspective on radioactive risk in early twentieth century, see Boudia, Soraya; Fellinger, Anne (2007). "Radioactivité et santé au travail : trajectoire historique d'un problème". Histoire et sociétés 23: 32-43. On Byers case, see Macklis, Roger M. (1993). "The Great Radium Scandal" *Scientific American* 269(2):

related to this topic, I will argue that its Jesuit editors consciously or unconsciously shaped an image of the discipline according to their elitist, utilitarian and antievolutionist views characteristics of the magazine.

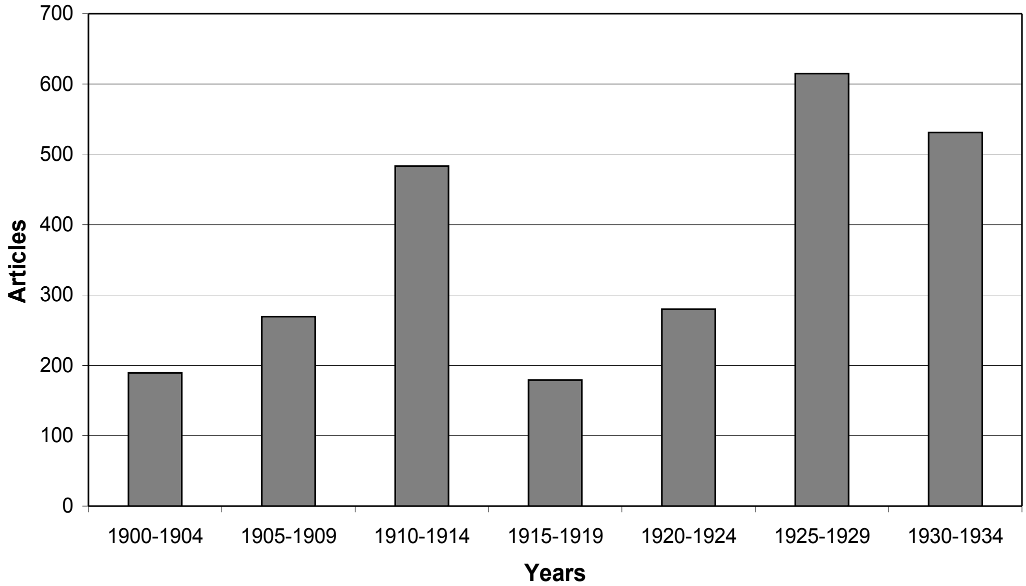

Fig. 2. Articles on "radium" in The Times, 1900-1934.[31]

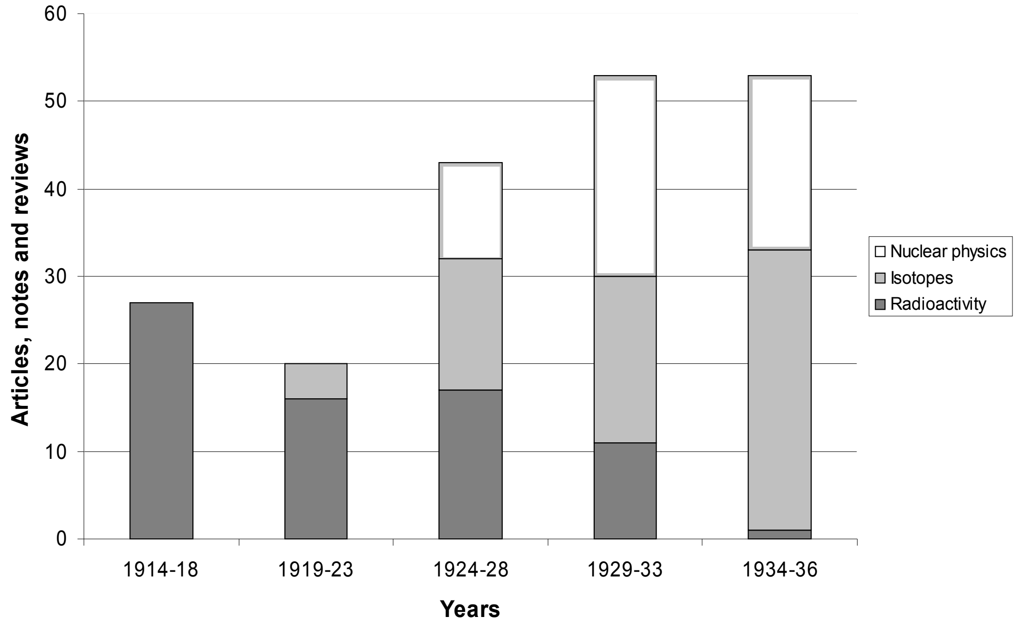

Fig. 3: Articles, notes and reviews published in Ibérica, according to research field, 1914-36.

94-99. The most complete analysis of the "radium girls" case is Claudia Clark (1997). *Radium Girls: Women and Industrial Health Reform, 1910-1935*. Chapel Hill: University of North Carolina Press.

31 Source: Times Digital Archive.

Between 1914-1936, 72 articles and 13 book reviews were published having radioactivity or radium as main topic. Additionally, other 124 articles were published about nuclear physics and isotopes in this same period, this areas increasingly becoming more prominent in the public sphere in the late 1920s and 1930s in detriment of "classical" radioactivity (figure 2). It is interesting to note, however, that references to the new concept of isotope only appeared in *Ibérica* after 1922, just after the award of the Nobel Prize for Chemistry to Francis William Aston for the invention of the mass spectrograph. Developments previous to this event, like the formulation of the isotope hypothesis by Soddy in 1913 or Aston's early experiments in 1919-1920, were ignored by the magazine. This observation agrees with Jeff Hughes recent assessment of Aston's work, which argues for the importance of the Nobel prize in the acceptance of the isotopic theory of matter.[32]

By examining the 72 articles on radioactivity, it appears that more than a quarter of them are devoted to generic popularisation of radioactivity, that is, to the description of the radioactive phenomena, explanations about its cause and the broad survey of its applications (see table 1). The articles are evenly distributed on time, and take for granted Rutherford's disintegration hypothesis (origin of radioactivity in the disintegration of atomic nuclei).[33] It doesn't seem that the anti-Rutherdfordian views of José Muñoz del Castillo, director of Madrid's Institute of Radioactivity and dean of the discipline in Spain, had much impact on the magazine approach.[34] This observation reinforces the impression that *Ibérica* relied on foreign sources of scientific news, such as magazines, scientific journals and books, thanks to its up-to-date library of the *Observatorio del Ebro* and exchanges with other institutions.

In this extent, it is noticeable that France was the main source of information in the first decade of the magazine. Of eight published reviews of books related to radioactivity in the period, seven were French and one Spanish, being some of the French books translations of books originally written in German or English.[35] However, references to English and American research increased from late 1920s. Some attention was also given to Spanish developments, as *Ibérica* periodically published short news about courses, conferences and institutional or technical developments in Spain. This is the case, for example, of the courses of radiotherapy

32 Hughes, Jeff (2009). "Making isotopes matter: Francis Aston and the mass-spectrograph", *Dynamis* 29: 131-165. The paper belongs to an issue of *Dynamis* devoted to the history of isotopes in the 20th century.

33 See, for example: Puig, Ignacio (1923). "La desintegración de los elementos". *Ibérica* 506: I-IV.

34 Muñoz del Castillo had founded the first Spanish laboratory of radioactivity in Madrid in 1904. He tried to institutionalize the discipline by extolling radioactive waters therapeutic virtues and the promises of radioactive materials as fertilizers. Muñoz succeeded to get the support of Spanish authorities, which provided his laboratory (that become research institute in 1911) with material and human resources, but his international prestige was virtually nil. Among the factors explaining the incapacity of Madrid's Institute of Radioactivity to connect with international networks of radioactive research (and, in some extent, his decline in the 1920s) we can count the limitation of his communication strategy to the national scale, the dependence on foreign instruments and radioactive elements and, last but not least, the inexistence of a Spanish industry of radium that might have established synergies with the university laboratory and provided employment opportunities for its students. On Madrid's laboratory, see Herran, Néstor (2008). *Aguas, semillas y radiaciones. El laboratorio de radiactividad de la Universidad de Madrid, 1904-1929*. Madrid: CSIC. An abridged English version of this history has been published as Herran, Néstor (2008). "Waters, Seeds and Radiation: Radioactivity Research in Early Twentieth Century Spain", in ed. Josep Simon et al., *Beyond Borders: Fresh Perspectives in History of Science*. Newcastle: Cambridge Scholars Publishing, pp. 325-344.

35 Interestingly, France was the main recipient of JAE's fellows until the late 1920s, when Germany took the lead.

offered by the university of Granada in 1921, the creation of the Spanish Society of Electrotherapy and Radiology, the establishment of a society for securing radium for Catalan physicians in Barcelona, the production of electrometers in Madrid's Institute of Radioactivity, or the coverage of Marie Curie in Madrid in April 1931.[36]

Topic	Articles	Percent
Generic popularisation of radioactivity	20	28%
Medical uses (including dangers of radium)	15	21%
Production, prospecting, prices of radioactive substances	11	15%
Use of radioactivity in biology and agriculture	7	10%
Instruments, standards and experiments	7	10%
Institutions, obituary, social events	6	8%
Industrial uses	3	4%
Geochronology	3	4%

Fig 4: Main topics of articles published on Ibérica about radioactivity, 1914-1936

In any case, the magazine editors suited the information received according their own aims and ideology. This is especially noticeable in the case of evolution, being Jesuits the leaders of the opposition to this science inside the catholic church.[37] For example, in April 1931 *Ibérica* published a translation of Millikan's speech at December 1930 congress of the AAAS, which had been published in *Science* four month before.[38] The translated version omitted the introduction, in which Millikan counted evolution as one of the most important scientific advances in the last century. In this same vein, the use of radioactivity in the dating the age of Earth were also regarded with suspicion. For example, in 1916, Arthur Holmes attribution of 1500 million years to Earth's age based on radium decay rate was qualified as "hypothetical" regarding the "current state of science". In 1925, we found a more balanced analysis of the question in an article of Ignacio Puig, vice-director of the *Observatorio del Ebro*. However, he still assumed that this knowledge was "imperfect" and announced that we should wait for a long time until we know the real Earth's age.[39] In contrast, women's role in radioactivity

36 "Crónica Científica: Reconocimiento y determinación de los minerales de radio y torio". *Ibérica* 261 (18 January 1919): 35; "Crónica Científica: Nueva Sociedad Española de electrología y radiología", *Ibérica* 90 (18 September 1915): 178; "Crónica Científica: Sociedad del Radio", *Ibérica* 32 (8 August 1914): 82 ; "Crónica hispanoamericana: Cursillo de Radioterapia en la Universidad de Granada". *Ibérica* 399 (29 October 1921): 242-3; " Crónica hispanoamericana: Conferencias de Mme. Curie en Madrid", *Ibérica* 884 (27 June 1931): 2.

37 Artigas, Mariano; Glick, Thomas; Martínez, Rafael A. (2006). *Negotiating Darwin. The Vatican confronts evolution 1877-1902*. Baltimore: The Johns Hopkins University Press

38 Millikan, Robert A. (1931). "Estado presente de la teoría y de la experimentación en lo concerniente a desintegración y síntesis atómica", *Ibérica* 876 (2 April 1931): 285-7, and 877 (9 April 1931): 302-4. The original version of the paper is Millikan, Robert A. (1931). "AAAS Presidential Address: Present Status of Theory and Experiment as to Atomic Disintegration and Atomic Synthesis," *Science* (2 January 1931): 73:1-5.

39 "Crónica Científica: La Edad de la Tierra valuada por los fenómenos radioactivos". *Ibérica* 143 (23 September 1916): 197. Puig, Ignacio (1925). "Determinación de la edad de los terrenos por la radioactividad". *Ibérica* 608: 395-7.

research did not seem to be much ideologically affected. Even if some prominent women radioactivists like Marietta Blau were assumed to be men in short news, [40] Marie Curie pioneering role was generally acknowledged and celebrated.

The medical use of radium was the second major topic of radioactivity-related articles in *Ibérica*. In this area, the journal provided a generally positive view of radium-based treatments, reporting international and local initiatives for establishing Radium institutes and other medical institutions. However, the magazine also gave voice to surgeons critics of radium therapy like Ricardo Lozano, who in the early 1920s reacted against radium emanation therapy on medical efficiency:

> When a sudden frenzy to acquire radium for therapy affected Spain, I felt sceptic and even revolted about employing an element scientifically unknown, of impossible dosage. It is not enough to read cases of healing by radium in newspapers; before employing it, we need to have a scientific basis about its composition and how it affects the body, chemically and physically, and we must consider the damage we can cause on our patients after an imprudent application: 'premium non nocere'. This is the reason why I abstained from acquiring radium and even to recommend it to my patients, with the exception of two or three I considered incurable by other means.[41]

Ibérica also published two articles commenting on the possible dangers of radium, but only in relation to the possible danger to physicians or researchers dealing with x-ray and radium on a daily basis, and heroically portrayed as "victims of radiology".[42] Consumer concerns, like those expressed in relation to the Byers case, or work safety concerns, like those involved in the radium dial painters' case, were not addressed by the magazine.

The third topic most covered in the pages of *Ibérica* was the state of radium industry, especially focusing on prospecting and on the pricing of this element. The discovery of new deposits in Colorado (1915) and the Belgian Congo (1923) and their effects on prices and movements of the radium market were routinely commented in the news section of the journal. [43] These articles provide a wealth of information about prices. In contrast with critiques of the elitist character of radium treatments we found in the anarchist and socialist press, they generally show a condescending view of the radium market. The high price of radium is justified because of its exploitation costs, and the market will ultimately solve the supply problem by fostering the discovery of new deposits. Obsession with the wealth provided by radioactivity the magazine is also reflected in its constant interest on hypothetical transmutations (mostly of mercury into gold, etc.), even if most of the news finish by generally refuting this possibility.[44]

40 "Crónica general: Los rayos H y la desintegración de los elementos", *Ibérica*. 780 (1 June 1929): 343.

41 Lozano, Ricardo (1922). "Impresión de un viaje científico. La radioterapia y la cirugía en algunos casos de tuberculosis – el radio", *Ibérica* 414: 90-93.

42 "Crónica general: Los peligros del radio". *Ibérica* 379 (21 May 1921): 326-7; "Víctimas de la radiología", *Ibérica* 974 (29 April 1933), p. 269-72.

43 "Crónica Científica: La producción de Radio en Colorado", *Ibérica* 91 (25 September 1915): 196; "Crónica general: Obtención de 100mg. de bromuro de radio", *Ibérica* 327 (8 May 1920): 294-5; "Crónica general: Disminución del precio del radio" *Ibérica* 468 (10 March 1923): 151; "Crónica general. La industria del radio", *Ibérica* 631 (5 June 1926): 292-5; "Crónica general: La cuestión del rádium", *Ibérica* 794 (21 September 1929): 166; "Existencia total y precios del radium", *Ibérica* 958 (7 January 1933): 5.

44 "Crónica general: El oro y los isótopos de mercurio", *Ibérica* 576 (2 May 1925): 280; "Crónica general:

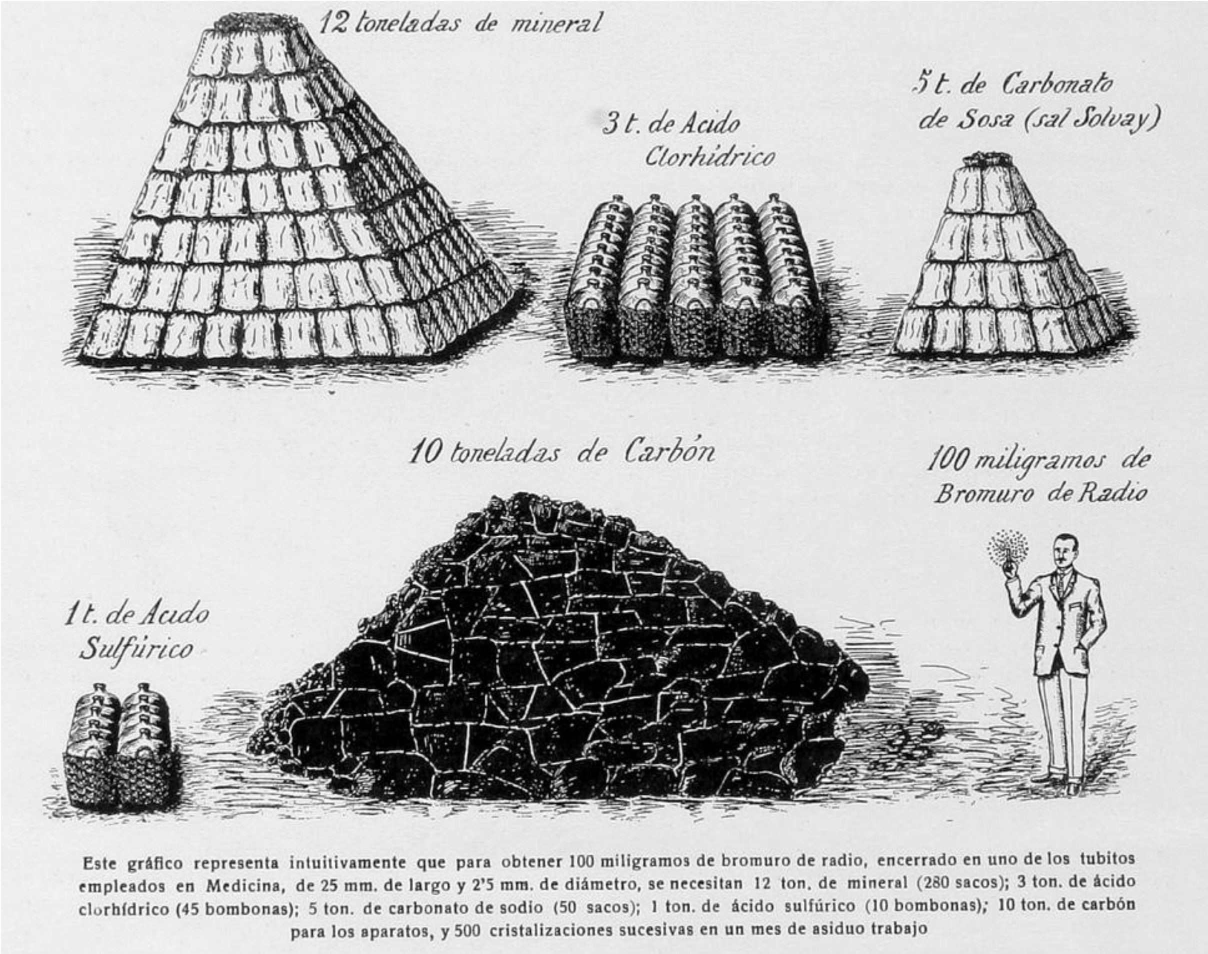

Fig. 5: "Obtaining 100 milligrams of radium bromide"[45]

In general, *Ibérica* held an optimistic perspective when addressing any kind of new application of radioactivity. A most treated topic was the application of radioactivity in agriculture, an area were Spanish researchers were especially interested on.[46] Several long reports on the question were published, in which the activities of Madrid's Institute of Radioactivity were described as "not surpassed by any foreign centre".[47] Indeed, researches of foreign scientists in this field were also enthusiastically commented. This is the case, for example, of Nodon and Cuvier's report to the Paris Academy of Science about the content of radioactivity in wine -found to be of the same order of mineral water, and inversely proportional to alcohol content-, which was supposed to be a good basis for including "radioactivity content" as an

Sobre la pretendida transmutación del mercurio en oro", *Ibérica* 602 (14 November 1925): 292-5; "Crónica general: Más resultados negativos en experimentos de transmutación de elementos", *Ibérica* 798 (19 October 1929): 231-2.

45 The footnote says: "This figure intuitively represents that, in order to obtain 100 milligrams of radium bromide for a medical vial measuring 25 mm long and 2,5 mm in diameter, there is necessary 12 tons of mineral (280 sacks); 3 tons of hydrochloric acid (45 canisters); 5 tons of sodium carbonate (50 sacks); 1 ton of sulphuric acid (10 canisters); 10 tons of carbon, and 500 successive crystallizations for a month of perseverant work" "Crónica general: Obtención de 100mg. de bromuro de radio", *Ibérica* 327 (8-5-1920): 294-5.

46 *Ibérica* devoted several long articles to the topic, such as Gorria, Hermenegildo (1914). "Radicultura". *Ibérica* 32:94-6, or Navarro, Benjamin (1917). "De Radioactividad II". *Ibérica* 187:75-8.

47 Navarro, Benjamín (1917). "De radioactividad". *Ibérica* 178: 345-50; 187: 75-78, and 180: 109-111.

standard wine feature.[48] Luminescent radioactive paintings and other inventions, such as Robert John Strutt's "radium clocks", also received a positive treatment in *Ibérica*. This kind of news provides are indeed interesting as they provide the only information we have on *Ibérica*'s audience: a letter requesting information about shops selling luminescent paintings in Barcelona. [49] Apart from that, information about readers' reaction is very scarce.

Conclusion

In his study of American Jesuit seismology, Carl-Henry Geschwind has argued that Jesuits "became involved in seismology not because of any deep interest in science for its own sake, but because they sought widespread publicity and general acclaim in a culture that celebrated science".[50] This same conclusion can be applied to the case of Spanish Jesuits by including also science popularization activities through *Ibérica*. Indeed, the magazine was instrumental to improve the quality of scientific training at Jesuit schools, and to shape a vision of science in harmony with Catholic dogma. In particular, the examination of *Ibérica*'s coverage of radioactivity reveals some of the strategies in dealing with scientific news of this magazine. Relying on selectively appropriated reports and self-tailored news of local developments, *Ibérica* generally presented a generally positive view of the science and applications of radioactivity and of science in general, and tried to capitalise on it. It stressed radioactivity positive effects and did not refer to some of the first cases of radium poisoning, which became to be prominent since the mid 1920s. Despite this attitude was not atypical in the period, it also reflects an obliging posture in reference to techno-scientific activity when this research did not treat the ethos supported by the journal's patrons. *Ibérica* style, combining didacticism with attention to economically sensible topics, aimed at providing top-down "vulgarisation", to make expert-produced science intelligible to the layperson according the 'dominant view' of popularisation.[51] The rhetoric of progress and utility shaped the journal's treatment and contents of news related to radioactivity, securing a "cordon sanitaire" for potentially disturbing findings like geochronology and the elitist character of radium therapy. In this sense, we can count *Ibérica* as participant of the civil discourse in the interwar period, but cannot disregard that its main objectives were ideological and should be considered as part of a civilised struggle, but in any case an important struggle, to appropriate science and to shape it according to very specific ideological aims.

48 "Crónica general: Radioactividad de los vinos". *Ibérica* 757 (22-12-1928): 375.

49 *Ibérica*. Suplement (may 1927): 20. The magazine had not a letters section, but in 1920s it included a monthly supplement were they could ask questions about scientific and technical topics.

50 Geschwind, 'Embracing Science and Research', p. 29.

51 Hilgartner, Stephen (1990). "The dominant view of popularisation: conceptual problems, political issues". *Social Studies of Science* 20: 519-539.

Some Notes on the Popularization of Quantum and Atomic Physics in Spain, 1914-1927*

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The popularization of science is an essential task for our societies and, in order to achieve this goal, the role of magazines aimed at the general public is fundamental. Consequently, we need to pay attention to such journals, as regards both their contents and the kind of audience they reach. In this paper we present a preliminary study on the early history of quantum and atomic physics in Spain, restricted to the magazine *Ibérica. El progreso de las ciencias y sus aplicaciones*, which was a pioneer in the field popularization and diffusion of science in Spain and played a significant role in propagating a great number of the most relevant studies in many scientific fields.

The Spanish journal *Ibérica* was founded in 1913 and had the objective of improving the diffusion of scientific and technological knowledge in Spain.[1] It began publishing regularly in January 1914, after two preliminary issues A and B, corresponding to October and November of 1913. Initially, and until 1925, the magazine was published at the Observatory of the Ebro, located at the town of Roquetas, near Tortosa, Tarragona province, in the Lower Ebro region of Spain.[2] This institution was founded in 1904 by the Jesuits and was initially dedicated to solar observation and geophysics; in 1913 it added to its objectives the diffusion of scientific and technological knowledge.[3] From the very first issues, the first director of the journal, Ricardo Cirera, also founder and first director of the observatory, stated the purpose of scientific discovery assumed by the new magazine: "making science accessible to all,"[4] which was associated with a willingness to undertake the task of explaining to everyone scientific and technological developments.[5]

* The author thanks Arne Schirrmacher for his very helpful clarifying comments on various topics and for the great assistance given in writing these notes.

1 For a general discussion of the social context in which *Ibérica* was launched, see the contributions of Nieto-Galán and Néstor Herrán in this preprint.

2 For a recent study on this journal, see Maria Genescà i Sitjes, "Ibérica: Primera revista de divulgación científica i tecnològica de l'Estat, editada a l'Observatori de l'Ebre (1913-1925)," *Actes d´Historia de la Ciència i de la Tècnica*, Nova època, vol. 1 (1), 2008, 377-386.

3 For a general bibliography on the scientists of the Company of Jesus at El Observatorio del Ebro, see the web site by Maria Genescà i Sitjes, URL= http://www.obsebre.es/php/biblioteca/jesuites/cientifics.htm.

4 ["Poner la ciencia al alcance de todos"].

5 Ricardo Cirera, S. J.; "La Ciencia al alcance de todos"; *Ibérica*; Spécimen A , 1-5; Spécimen B , 18-19.

The assumed importance of spreading scientific knowledge meant that the magazine would strive to achieve the widest possible distribution. To this end, two editions were published: a current one (the economical paper version) and a luxury one (the *couché* paper version), with identical contents; annual subscription prices for the weekly journal were 10 and 20 pesetas, respectively. It was also possible to receive the magazine in bound volumes, twice a year, at the respective costs of 6.50 and 12.85 pesetas for the semiannual and annual subscriptions. Given that this could be considered a modest price at the time, it is not surprising that *Ibérica* reached "a high circulation, more each day, in all Spanish-language countries, especially among people of good standing and belonging to the more enlightened classes," as was stated in all issues next to the subscription information, beside the price list.[6]

The magazine was edited by P. Ricard Cirera until 1917, when he was replaced by Jose Albiñana, who had been ordinary editor until 1915 and editor in chief during 1916; in 1923 direction passed to Andres F. Linari, a regular contributor to the magazine and its assistant director from 1918; all of these men were members of the Jesuit Order.[7]

The journal cover displayed an illustration of the river Ebro, by which it could be recognized until 1921 (Fig. 1). The journal appeared as a weekly publication from Tortosa until issue number 591, dated 15 August 1925, before moving its offices to Barcelona.

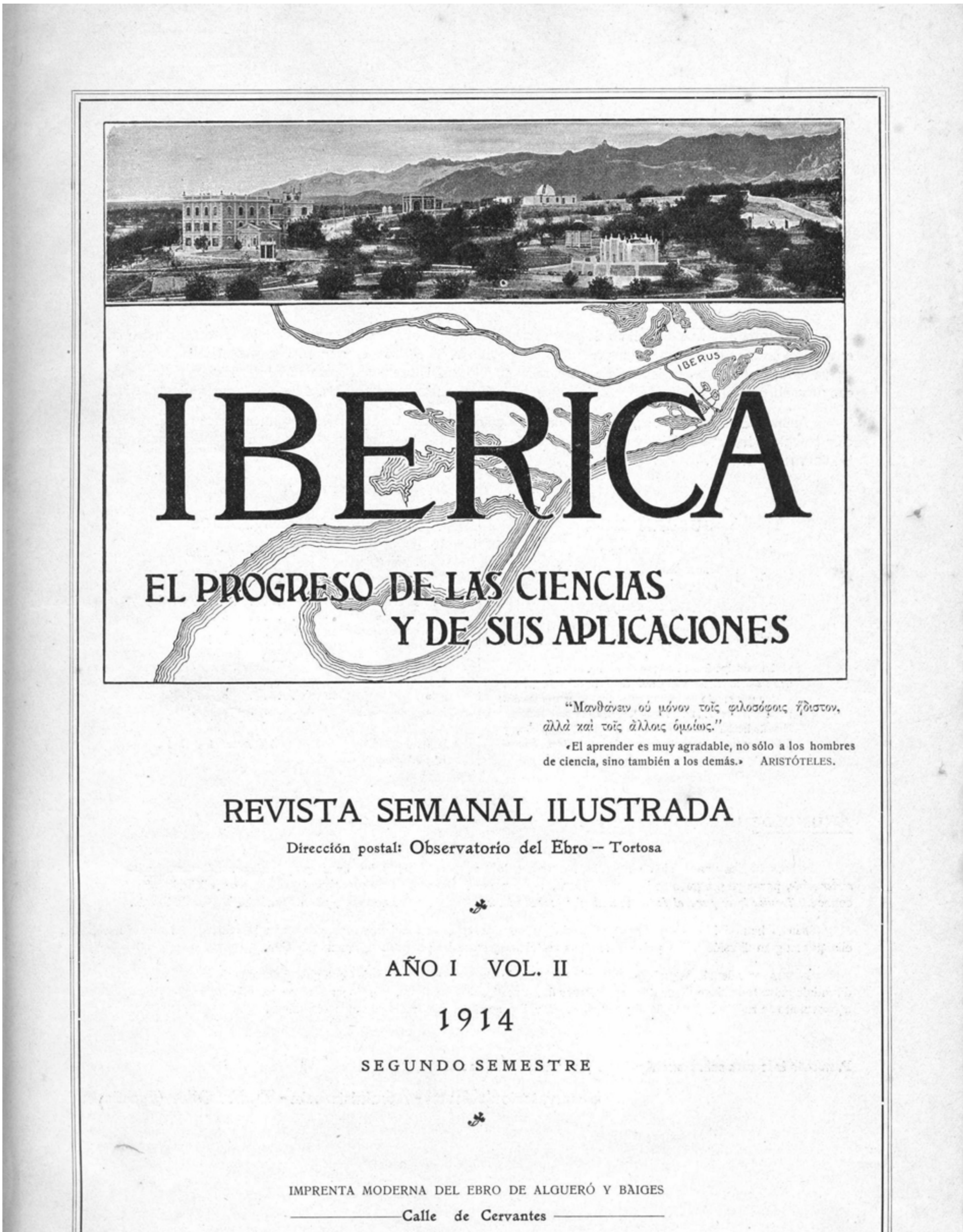
Under the panoramic photograph that occupies the upper part of the cover, a drawing of the Ebro River with the legend "Iberus" can be seen, used as background for the title of the journal. It is worth noting that the word *ibérica* (Iberian) comes from the ancient toponym *Iber*, also the source if the name of the Iberian Peninsula and Iberian peoples, and denoted rivers in general; this toponymy has been conserved in the Spanish name of the Ebro river, *Iberus Flumen*.[8] In this regard, the choice of the name *Ibérica* was justified by the first director and founder of the magazine, P. R. Cirera, as a means of evoking its connection to the scientific institutions that the Jesuit Order had established in Roquetas. There were three of these institutions: *the Laboratorio Químico del Ebro*, (Ebro's Chemical Laboratory), founded in 1905; the *Laboratorio Biológico del Ebro* (Ebro's Biological Laboratory), founded in 1910; and the *Observatorio del Ebro* (Ebro's Observatory), founded in 1904.[9] It is obvious that the term "*Ibérica*" (Iberian) could also be related to the stated purpose of reaching the entire Hispanic world, as *Iberia* was the name given to the peninsula now occupied by the states of Spain and Portugal, a Greek word equivalent to the word "Hispania," used mainly by the Romans (and of unclear etymology).

6 ["Una gran difusión, cada día mayor, en todos los países de lengua castellana, sobre todo entre las personas de buena posición y de las clases más ilustradas"].

7 Cf. M. Genescà i Sitjes, *op. cit*., p. 380.

8 The Latin form "Iberus" evolved to "Ebro," but "Iberus" was not the name of the river Ebro, as we know it today, but the Iberian word for any river: "iberus flumen" would be "río ibérico." However, and according to others, the hydronym "iberus flumen" can be explained from the Basque words "ibar" (estuary) or "ibai" (river); *cf*. X. A. Padilla García, *Escrituras y lenguas en la Hispania prerromana*, Biblioteca virtual Cervantes, http://www.cervantesvirtual.com/servlet/SirveObras/12361639910168273109213/p0000001.htm .

9 While the first two moved to Sarriá, Barcelona, in 1916, the Observatory continues in its original location today, as a University Research Institute of the University Ramón Lluch. Its official web aite, [http://www.obsebre.es/php/ quisom.php], includes a leaflet with pictures of the present installations, see [http://www.obsebre.es/ pdfs/visites_guiades_esp.pdf].


IBERICA

EL PROGRESO DE LAS CIENCIAS
Y DE SUS APLICACIONES

"Μανθάνειν οὐ μόνον τοῖς φιλοσόφοις ἥδιστον, ἀλλὰ καὶ τοῖς ἄλλοις ὁμοίως."
«El aprender es muy agradable, no sólo a los hombres de ciencia, sino también a los demás.» ARISTÓTELES.

REVISTA SEMANAL ILUSTRADA

Dirección postal: Observatorio del Ebro – Tortosa

AÑO I VOL. II

1914

SEGUNDO SEMESTRE

IMPRENTA MODERNA DEL EBRO DE ALGUERÓ Y BAIGES
Calle de Cervantes
TORTOSA

Fig. 1: Cover of the first volume of Ibérica, dated 1914

Also noteworthy is the quote from Aristotle written on the cover: "*El aprender es muy agradable, no sólo a los hombres de ciencia, sino también a los demás*" ("to learn gives the liveliest pleasure, not only to philosophers but to men in general"), in perfect agreement with the purpose of scientific popularization made by a magazine aimed at the general public.

Stages of publication of the journal *Ibérica*

There were three stages or periods in the publication of the journal *Ibérica*:

First period: 1914-1925. The journal was edited at the Observatory of Ebro, in Tortosa, Tarragona; during this stage the magazine was published weekly, forming two volumes per year of about 400 pages each, extending to 591 issues. This period coincides precisely with the development of the so-called "old quantum theory," of which the Bohr-Sommerfeld atomic model was an essential part. This is the period on which our study focuses.

Second period: 1925-1936. In 1925 the journal moved to Barcelona, where it continued as a weekly from issue number 592, dated 5 September (see figure 6), to issue number 1128, dated 18 July 1936, when the Spanish Civil War interrupted its publication. This period coincides to some extent with the main development of the new quantum formalism, when Born-Heisenberg matrix mechanics and Schrödinger's wave mechanics were developed.[10]

As stated in the magazine, the move from Tortosa was motivated because, given its wide circulation and high prestige, "a capital of more propitious scientific atmosphere for the publication of a weekly scientific magazine of the nature of Ibérica was required,"[11] as "prudence dictates that people and works, if practicable, be placed where they can give their best performance." Also, "given the importance of the publication," in Tortosa the means were lacking to manage the publication as it needed to be; the fact that the journal had been published for so long in Tortosa "in so fine a form as *Ibérica* sees the light of the public" was due to the astonishing efforts of its editors.[12]

The journal informed its readers about the move to Barcelona and explained its reasons on a full page (Fig. 2).

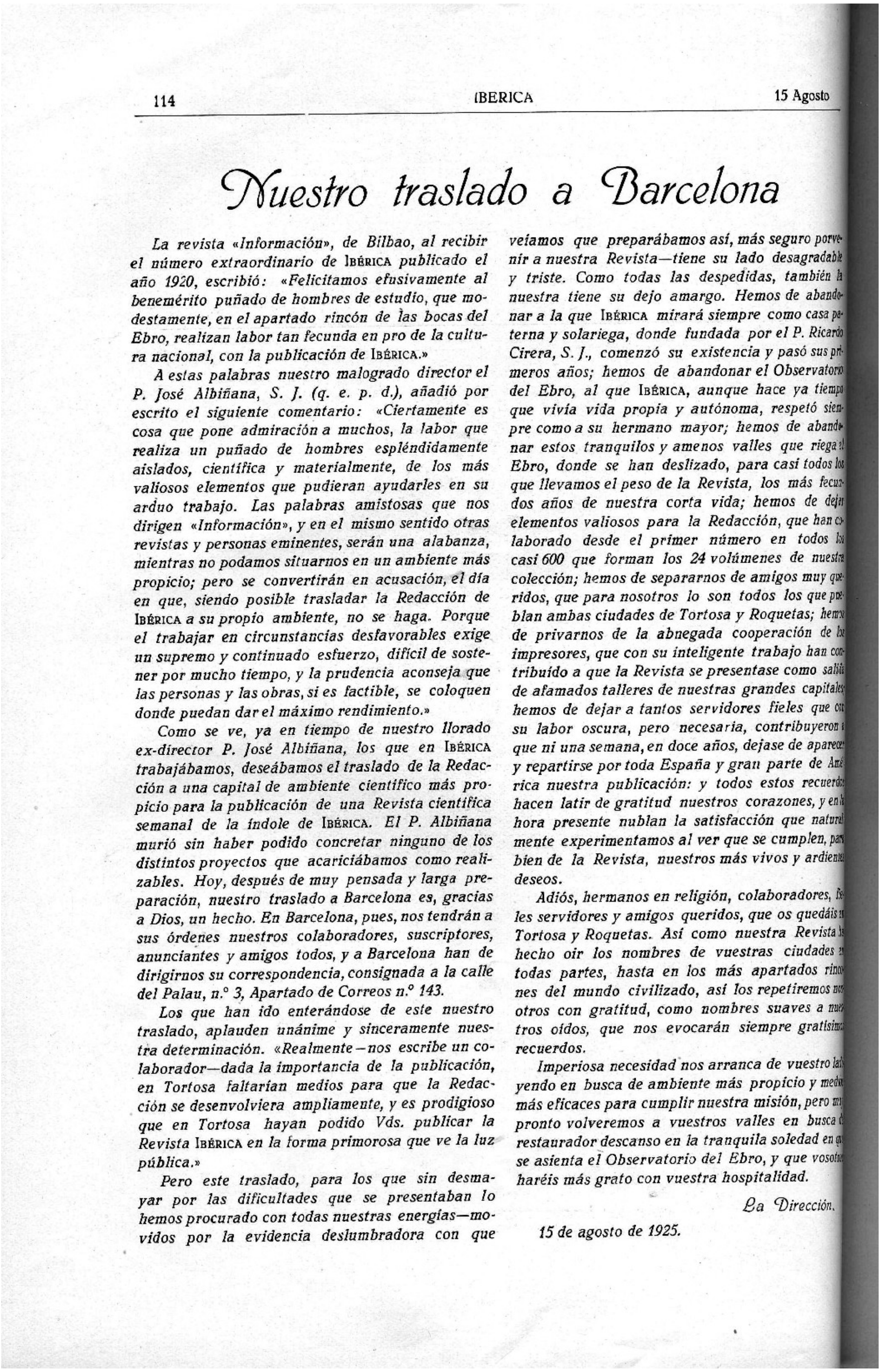
From its new location, the magazine would continue developing its task of spreading scientific knowledge with great efficiency, remaining for many years the leading popular scientific journal aimed at the Spanish-speaking general public.

Third period or "2ª época": 1945-2004. After the Spanish Civil War, which ended in 1939, publication of *Ibérica* was resumed in 1945, with a new first issue on 6 January. The journal

10 We recall that the fundamental work by J. von Neumann, *Mathematische Grundlagen der Quantenmechanik*, the first mathematically rigorous compendium of the new quantum formalism, was published in 1932, but it was not translated into Spanish until 1949.

11 Cf. *Ibérica*, Nº 590, 15 August 1925, p. 114. ["Una capital de ambiente científico más propicio para la publicación de una Revista científica semanal de la índole de *Ibérica*"].

12 ["La prudencia aconseja que las personas y las obras, si es factible, se coloquen donde puedan dar el máximo rendimiento"]; ["Realmente – nos escribe un colaborador - dada la importancia de la publicación, en Tortosa faltarían medios para que la Redacción se desenvolviera ampliamente, y es prodigioso que en Tortosa hayan podido ustedes publicar las Revista Ibérica en la forma primorosa que ve la luz pública"].



114 IBERICA 15 Agosto

Nuestro traslado a Barcelona

La revista «Información», de Bilbao, al recibir el número extraordinario de IBÉRICA *publicado el año 1920, escribió: «Felicitamos efusivamente al benemérito puñado de hombres de estudio, que modestamente, en el apartado rincón de las bocas del Ebro, realizan labor tan fecunda en pro de la cultura nacional, con la publicación de* IBÉRICA.»

A estas palabras nuestro malogrado director el P. José Albiñana, S. J. (q. e. p. d.), añadió por escrito el siguiente comentario: «Ciertamente es cosa que pone admiración a muchos, la labor que realiza un puñado de hombres espléndidamente aislados, científica y materialmente, de los más valiosos elementos que pudieran ayudarles en su arduo trabajo. Las palabras amistosas que nos dirigen «Información», y en el mismo sentido otras revistas y personas eminentes, serán una alabanza, mientras no podamos situarnos en un ambiente más propicio; pero se convertirán en acusación, el día en que, siendo posible trasladar la Redacción de IBÉRICA *a su propio ambiente, no se haga. Porque el trabajar en circunstancias desfavorables exige un supremo y continuado esfuerzo, difícil de sostener por mucho tiempo, y la prudencia aconseja que las personas y las obras, si es factible, se coloquen donde puedan dar el máximo rendimiento.»*

Como se ve, ya en tiempo de nuestro llorado ex-director P. José Albiñana, los que en IBÉRICA *trabajábamos, deseábamos el traslado de la Redacción a una capital de ambiente científico más propicio para la publicación de una Revista científica semanal de la índole de* IBÉRICA. *El P. Albiñana murió sin haber podido concretar ninguno de los distintos proyectos que acariciábamos como realizables. Hoy, después de muy pensada y larga preparación, nuestro traslado a Barcelona es, gracias a Dios, un hecho. En Barcelona, pues, nos tendrán a sus órdenes nuestros colaboradores, suscriptores, anunciantes y amigos todos, y a Barcelona han de dirigirnos su correspondencia, consignada a la calle del Palau, n.° 3, Apartado de Correos n.° 143.*

Los que han ido enterándose de este nuestro traslado, aplauden unánime y sinceramente nuestra determinación. «Realmente—nos escribe un colaborador—dada la importancia de la publicación, en Tortosa faltarían medios para que la Redacción se desenvolviera ampliamente, y es prodigioso que en Tortosa hayan podido Vds. publicar la Revista IBÉRICA *en la forma primorosa que ve la luz pública.»*

Pero este traslado, para los que sin desmayar por las dificultades que se presentaban lo hemos procurado con todas nuestras energías—movidos por la evidencia deslumbradora con que veíamos que preparábamos así, más seguro porvenir a nuestra Revista—tiene su lado desagradable y triste. Como todas las despedidas, también la nuestra tiene su dejo amargo. Hemos de abandonar a la que IBÉRICA *mirará siempre como casa paterna y solariega, donde fundada por el P. Ricardo Cirera, S. J., comenzó su existencia y pasó sus primeros años; hemos de abandonar el Observatorio del Ebro, al que* IBÉRICA, *aunque hace ya tiempo que vivía vida propia y autónoma, respetó siempre como a su hermano mayor; hemos de abandonar estos tranquilos y amenos valles que riega el Ebro, donde se han deslizado, para casi todos los que llevamos el peso de la Revista, los más fecundos años de nuestra corta vida; hemos de dejar elementos valiosos para la Redacción, que han colaborado desde el primer número en todos los casi 600 que forman los 24 volúmenes de nuestra colección; hemos de separarnos de amigos muy queridos, que para nosotros lo son todos los que pueblan ambas ciudades de Tortosa y Roquetas; hemos de privarnos de la abnegada cooperación de los impresores, que con su inteligente trabajo han contribuido a que la Revista se presentase como salida de afamados talleres de nuestras grandes capitales; hemos de dejar a tantos servidores fieles que con su labor oscura, pero necesaria, contribuyeron a que ni una semana, en doce años, dejase de aparecer y repartirse por toda España y gran parte de América nuestra publicación: y todos estos recuerdos hacen latir de gratitud nuestros corazones, y en la hora presente nublan la satisfacción que naturalmente experimentamos al ver que se cumplen, para bien de la Revista, nuestros más vivos y ardientes deseos.*

Adiós, hermanos en religión, colaboradores, fieles servidores y amigos queridos, que os quedáis en Tortosa y Roquetas. Así como nuestra Revista ha hecho oir los nombres de vuestras ciudades en todas partes, hasta en los más apartados rincones del mundo civilizado, así los repetiremos nosotros con gratitud, como nombres suaves a nuestros oídos, que nos evocarán siempre gratísimos recuerdos.

Imperiosa necesidad nos arranca de vuestro lado, yendo en busca de ambiente más propicio y medios más eficaces para cumplir nuestra misión, pero muy pronto volveremos a vuestros valles en busca de restaurador descanso en la tranquila soledad en que se asienta el Observatorio del Ebro, y que vosotros haréis más grato con vuestra hospitalidad.

La Dirección.

15 de agosto de 1925.

Fig. 2: Ibérica, Nº 590, 15 August, 1925, p. 114

changed its format, added "2ª época" to the cover title, and began numbering again from issue 1, continuing until 2004, when it ended for good. In this third stage the journal failed to reach the circulation of earlier eras, and the publication frequency was progressively reduced, probably due to reasons of budget and market fitness: from its reappearance in 1945 until 1961 it changed to fortnightly publication; finally, in 1962, it became a monthly until its demise in 2004.

A closer look at the first stage of publication: 1914-1925

In these preliminary notes, we focus only on the first stage of publication of the journal, from January 1914 until August 1925. This was a crucial time for science in Spain, since during the first third of the 20th century scientific development experienced a big boost, after the establishment of the *Junta para la Ampliación de Estudios e Investigaciones Científicas* (Council for the Extension of Studies and Scientific Research) or JAE, in 1907,[13] an institution under the Ministry of Education. The JAE developed an extensive scientific and cultural program, focused mainly on basic research, and not only "represented the most innovative project in Spain between 1907 and 1939, involving as it did the creation of laboratories and research centers, the awarding of scholarships to study abroad, etc. but also brought leading Spanish thinkers and scientists into contact with those in countries and on other continents, thus opening up a new way of bringing peoples together through science and culture."[14]

There is general agreement that, because the development of Spanish science was retarded in the nineteenth century, Spain did not join in the Industrial Revolution; in 1914, it was still a predominantly agrarian nation. Furthermore, the conditions necessary for the effective development of physical and chemical sciences and associated technologies were not achieved until this century.[15] In this context, the founding of the JAE promoted scientific research, since it ran an active program of grants enabling students to pursue advanced studies in Spain and abroad, and sent many delegations to scientific conferences. The JAE also set up various research centers and laboratories throughout Spain, including the *Instituto Nacional de Ciencias Físico-Naturales* (National Institute of Physical and Natural Sciences), founded in 1910, under the presidency of Santiago Ramón y Cajal. It grouped together existing institutions and included various laboratories, like the *Laboratorio de Investigaciones Físicas* (Physical Research Laboratory),[16] under the direction of Blas Cabrera.[17] The work developed in these

13 For a brief general discussion on science in Spain during this period, see José M. Sánchez Ron, "Un siglo de ciencia en España" y "Física, Química y Matemáticas en la España contemporánea", in *Un siglo de ciencia en España e imágenes de la ciencia en la España contemporánea*, Publicaciones de la Residencia de estudiantes, Madrid, 1998, 16-43 and 114-139.

14 Cf. "History of CSIC. Before the CSIC: The JAE.", from the official web of CSIC, Consejo Superior de Investigaciones Científicas (Spanish National Research Council), the organization created after the Spanish Civil War in 1939 to replace the JAE; URL = http://www.csic.es/historia.do . For a general study on JAE, see J.M. Sánchez Ron, coord., *La Junta para la Ampliación de Estudios e Investigaciones Científicas 80 años después*, CSIC, 2 vols., Madrid, 1988.

15 Cf. J.M. Sánchez Ron, *ibid*., 28 and 31.

16 The laboratory had five lines of research: magnetochemistry, physical chemistry, electrochemistry and spectroscopy electroanalysis; it contributed enormously to developing physics research in Spain.

17 Blas Cabrera y Felipe was a great Spanish physicist, mainly an experimental one, who developed an important research activity in the field of the magnetic properties of matter. He discovered the law that describes the

centers gave a great impulse to Spanish science, which was reflected at the time in the pages of *Ibérica*.

By coincidence, this first stage of publication from 1914 to 1925 covers a very exciting time in physics. For this reason let me briefly summarize some of the main events that can be seen as the precursors of the new quantum formalism that would be founded in 1925:

1911: After the Geiger alpha scattering experiments by Marsden and Rutherford in Manchester, and their adjustment by the Rutherford formula, the planetary or nuclear model of atom was formulated.

1913: The Bohr atomic model was published,[18] finding early application to the study of atomic spectra. In the same year, Moseley formulated his famous empirical law concerning the characteristic x-rays emitted by atoms.[19] This led to a confirmation of the Bohr's model in the following year, when it was proposed that the formula could be explained in terms of the law as long as certain additional assumptions were made about atomic structure. Also in this year, the Stark effect was discovered,[20] which states that the spectral lines of hydrogen are split into components by an external electric field.

1914: James Franck and Gustav Hertz performed their famous experiment which demonstrated the existence of excited states in mercury atoms,[21] providing strong evidence that Bohr's model of atoms with quantized energy levels was correct.

1916: Arnold Sommerfeld developed his corrections to Bohr's atomic theory. He devised a modified version of Bohr's model by incorporating the relativistic variation of the mass of an electron moving around an atomic nucleus; the model supplemented the quantized angular momentum condition of the Bohr model with an additional radial quantization condition, replacing circular orbits with elliptical ones,[22] and was able to explain the fine structure of the hydrogen spectrum. Later, he developed a perturbative scheme and introduced a new quantum number to account for the Zeeman effect, or the splitting of spectral lines due to magnetic fields. In 1919 he published the book *Atombau und Spektrallinien*,[23] which became a fundamental text of the new atomic theory.

changes in the magnetic moments of the atoms of the iron family (*curve Cabrera*); modified the Curie-Weiss law, which describes the magnetic susceptibility of a ferromagnetic material in the paramagnetic region situated beyond the Curie point, and derived an equation to describe the magnetic moment of atoms taking into account the effect of temperature. He worked at various European research centers as well as in the International Bureau of Weights and Measures in Paris.

18 N. Bohr, "On the constitution of Atoms and Molecules. Part I.," *Philosophical Magazine and Journal of Science*, 26, 1913, 1-25.

19 H.G. J. Moseley, "The high frequency spectra of the elements," *Phil. Mag.*, 26, 1913, 1024-1034.

20 J. Stark, "Observation of the separation of spectral lines by an electric field," *Nature* 92, 1913, p. 401; the effect was discovered simultaneously and independently by the Italian A. Lo Surdo.

21 J. Franck and G. Hertz, "Über Zusammenstöße zwischen Elektronen und Molekülen des Quecksilberdampfes und die Ionisierungsspannung desselben," *Verhandlungen der Deutschen Physikalischen Gesellschaft* 16, 1914, 457-467.

22 A. Sommerfeld, "Zur Quantentheorie der Spektrallinien," *Annalen der Physik* 51, 1916, 1-94; "Zur Quantentheorie der Spektrallinien (Fortsetzung)," *Annalen der Physik* 51, 1916, 125-167.

23 A. Sommerfeld, *Atombau und Spektrallinien*, Friedrich Vieweg und Sohn, Braunschweig, 1919.

1922: The Stern–Gerlach experiment was performed by Otto Stern and Walther Gerlach;[24] it was meant to test the Bohr–Sommerfeld hypothesis that the direction of the angular momentum of a silver atom is quantized; later, it was clearly understood to be the first direct experimental evidence of the electron spin.

1923: Arthur H. Compton explained the presence of a wavelength shift in diffused radiation, showing a decrease in energy (or increase in wavelength), when a high-energy X-ray or gamma ray interacts with matter; this phenomenon could not be explained in terms of classical wave theory, thus lending support to Einstein's photon theory. This Compton Effect (also called *Compton scattering*) is the result of a high-energy photon colliding with a target, which releases loosely bound electrons from the outer shell of the atom or molecule.

1924: M. Louis de Broglie presented his doctoral thesis *Recherches sur la Théorie des Quanta* (Research on quantum theory) at the Faculty of Sciences of Paris, where he introduced his theory of electron waves, an idea conceived in 1923 and first experimentally confirmed in 1927 by C. Joseph Davisson and Lester H. Germer.

1925: formulation of the exclusion principle by Wolfgang Pauli ("no two electrons in the same atom can be in the same quantum state, this is, have identical quantum numbers"). In the same year, George Uhlenbeck and Samuel Goudsmit published the hypothesis of the intrinsic angular momentum or spin of electrons.

Our aim is to investigate which of these events were referred to, or at least mentioned, in the pages of the magazine. In order to do this, in the following graph we first present statistics of the number of references to modern quantum and atomic physics, including papers and announcements, and reviews or summaries of lectures and books:

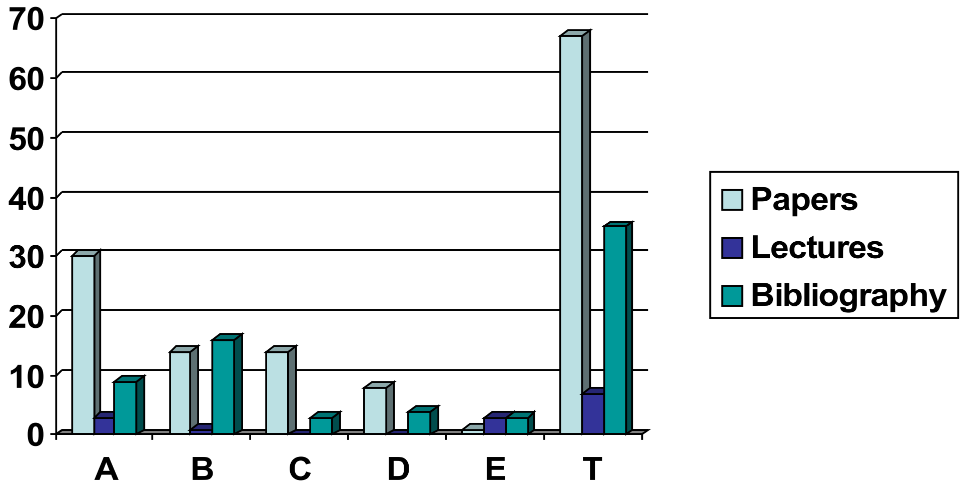


Fig. 3: Articles published in Ibérica during the first stage of the journal (1914-15 Aug. 1925) divided by physical fields.

24 W. Gerlach and O. Stern, "Das magnetische Moment des Silberatoms," *Zeitschrift für Physik* 9, 1922, 353-355.

The analysis is divided into 1) papers, notes (short texts frequently not signed) and extensive lecture summaries; 2) lecture announcements, and 3) bibliographical references (many of them with short reviews). The capital letters stand for:

A: X-ray and other radiation (including applications)

B: Atomic structure (including general review papers which refer to new atomic models)

C: Spectroscopy; Zeeman, Paschen and Stark effects

D: Atomic elements, isotopes

E: Others (Planck and the quanta; photoelectric effect; others)

T: Total items during the whole period (from 1914 to August 1925)

Clearly the X-ray and its applications was the favorite topic, but the new atomic theory was also conveniently related to the readers of the journal. In order to elucidate the kind of paper published, we next present a selection of entries computed in the previous graph; all are items that discuss the new physics theories on atomic structures and spectral analysis (types **B** and **C** in the previous graph). We have selected them as significant instances of the physics topics discussed in the journal; it is also important to pay attention to the corresponding times of publication:

1. (B-paper). "On the hypothesis of the electrons, synthesizing hypothesis of Modern Physics"[25]; José Mª Plans[26]; *Ibérica*, Nº 50, 12 December 1914, pp. 382-383. This is the third part of a long article that was published in three parts (so in the graph it was counted as three items). The content of the article was developed under two headings, "On the hypothesis of electrons" and "The hypothesis of revolutionary electrons."[27] The most interesting thing is that in the text the author stated that "we can, therefore, consider the atom like a kind of solar system formed by a thick positive electron, around which negative electrons orbit like small planets, attracted by the electricity of opposite value in the central electron; the negative charges of these planets compensate for the positive charge of the sun, so that the algebraic sum of all charges is null."[28] Thus, without making any explicit reference to Rutherford, a planetary model for the atom is offered to the reader.

It is interesting to comment that, despite this early exposition of a planetary model for the atom, we did not find any specific reference to the nuclear atomic model until 1917, when a note (short texts usually not signed) headed "Properties of slow canal-rays" (*Ibérica*, Nº 181, 23 June 1917, p. 389) refers to an experiment by Dempster, which was published in *Physical Review* vol. VIII, p. 651.[29] Its results supposedly refuted Bohr's atomic model, since "it considers the emission of light as determined by the return of an electron to a positive center, but

25 ["Sobre la hipótesis de los electrones, hipótesis sintetizadora de la Física Moderna"].

26 José María Plans y Freyre was a Spanish physicist and mathematician, pioneer in the introduction of the theory of relativity in Spain.

27 ["Sobre la hipótesis de los electrones"] and ["La hipótesis de los electrones revolucionaria"].

28 ["Podemos, por tanto, considerar al átomo como una especie de sistema solar formado de un grueso electrón positivo, alrededor del cual giran, como pequeños planetas, electrones negativos, atraídos por la electricidad de nombre contrario del electrón central, las cargas negativas de estos planetas compensan la carga positiva del sol, de modo que la suma algebraica de todas las cargas en nula"].

29 A. J. Dempster, "The Properties of Slow Canal Rays," *Physical Review* VIII (6), 1916, 651-662 (dated 1 Dec. 1916).

it seems better to admit that the collision of neutral particles is sufficient, according to Dempster, to produce light directly."[30] After that, the next reference we found to Bohr's model in *Ibérica* appears in 1921 (N 395, p. 191), in the Bibliography section; this note is the following item in the list.

2. (B-bibliography). Note in *Ibérica*, Nº 395 (1 October 1921), p. 191. It offered a short review of the book *Report of the Quantum Theory of Spectra* by L. Silberstein,[31] a positive report which uses the following words to introduce the Bohr's model: "an opuscule that summarizes the considerations of Bohr, Sommerfeld and others who have applied Planck's theory of quanta to the study of spectral rays (…) The nucleus or positive ion of an atom attracts the electrons or negative electric charges according to the law of Newton, and it forces them to describe elliptical orbits according to the laws of Kepler; only a certain *number* of them are stable, those whose angular momentum is an exact multiple of Planck's constant divided by 2π, and this hypothesis by Bohr is the basis for their discontinuous spectral theory; the spectra of the elements of very small atomic weight (H and helium) are those that better adapt to the consequences of the new theory, by means of which it has even been possible to predict some facts, which has lent it great prestige among the experts. The explanation is very acceptable with respect to its order and precision, and we judged it suitable for all who have studied theoretical physics and want to have a clear idea of this new chapter of the field."[32]

3. (C-paper). **"**Some procedures used in spectral analysis"[33]; Miguel Catalán Sañudo[34]; *Ibérica*, Nº 142, 16 September 1916, pp. 186-189. In this paper M. Catalán, who was just beginning his career as a researcher at the *Laboratorio de Investigaciones Físicas de Madrid*, made a general presentation of the spectrographic work that was being carried out in Madrid by some other researchers and himself. It is interesting to note that Catalán would later discover multiplets in the spectrum of manganese,[35] a crucial discovery for the interpretation of the spectra of complex atoms by Sommerfeld in 1923.[36]

30 ["Considera la emisión de luz como determinada por el regreso de un electrón a un centro positivo, pero parece preferible admitir que el choque de partículas neutras basta, según Dempster, para producir directamente la luz"].

31 L. Silberstein , *Report of the Quantum Theory of Spectra*; A. Hilguer Ltd., Londres, 1920.

32 ["Un opúsculo resumen de las consideraciones de Bohr, Sommerfeld y otros, que han aplicado la teoría de los quanta de Planck al estudio de los rayos espectrales (…) El núcleo o ión positivo de un átomo atrae a los electrones o cargas negativas según la ley de Newton, y los obliga a describir órbitas elípticas según las leyes de Kepler; *sólo cierto número*, aquéllas cuyo momento angular es un múltiplo exacto de la constante de Planck, dividida por 2π, *de estas órbitas son estables*, y esta hipótesis de Bohr es la base de su teoría espectral discontinua; los espectros de los cuerpos simples de muy pequeño peso atómico (H y helio) son los que mejor se adaptan a las consecuencias de la nueva teoría, y hasta, mediante ella, se han podido predecir algunos hechos, lo cual le ha dado sumo crédito entre los peritos. La exposición es muy aceptable por su orden y precisión, y la juzgamos apta para todos los que habiendo estudiado Física teórica, quieren tener una idea clara de este nuevo capítulo de la misma"].

33 ["Algunos procedimientos empleados en el análisis espectral"].

34 Miguel Ángel Catalán Sañudo was a great Spanish physicist, known for his outstanding work as a spectroscopist. He studied the optical spectra of complex atoms and established that it consisted of groups of lines, called "multiplets," which exhibited certain characteristic regularities; his findings led to a deeper understanding of atomic structure. He published more than 70 scientific articles in specialized journals. For more information about him, see *Miguel Catalán. Su obra y su mundo*; CSIC/Fundación Menéndez Pidal, Madrid, 1994.

35 M. A. Catalán,"Series and other regularities in the spectrum of manganese," *Philosophical Transactions* A 223, 1922, p. 127.

36 A. Sommerfeld, *Annalen der Physik* 70, 1923, 32-62.

4. (B-note). Note in *Ibérica*, Nº 455 (9 December 1922), pp. 341-342, headed “Modern theories on spectral lines.”[37] It contains a brief description of the Bohr model and the later Sommerfeld corrections; the text includes a mention of the recent findings on the helium spectra by Fowler and Paschen. These two researchers had observed new spectral lines that, as it is stated in the note, were explained by the Sommerfeld theory, confirming what the text called the “Rutherford-Bohr-Sommerfeld atomic hypothesis.”

5. (B-lecture). Note in *Ibérica*, Nº 430 (3 June 1922), pp. 343-344, entitled “Lectures by Professors H. Weyl, A. Sommerfeld, O. Hönigschmid and K. Fajans at the University of Madrid.” It reported on of the corresponding series of lectures; in particular, it noted the six lectures held by Sommerfeld in Madrid, in April 1922. The note indicated only the titles of the six lectures, praising their author and referring any readers interested in obtaining more data on the subjects discussed to Sommerfeld’s fundamental text *Atombau und Spektrallinien*.[38] However, a bibliographical reference to this seminal book did not appear in *Ibérica* until the next year, 1923, see item 6. During these lectures, M. Catalán established personal contact with Sommerfeld, and this would allow him to embark on a subsequent research visit in Munich.[39]

The titles of the six lectures, as listed in the note, were:[40] 1. Fundamentals of the Bohr theory, the hydrogen atom spectrum; 2. The fine structure of the spectrum of hydrogen; 3. The theory of X-ray spectra; 4. The fine structure of X-ray spectra; 5. Optical spectra in general. 6. Mathematical complements on phase integrals.

The following final comment is made in the note: “This whole matter of the constitution of the atom and the fine structure of the spectrum, was exposed brilliantly by the lecturer in his work *Atombau und Spektrallinien* (...). His thoughts on the quantification of energy, the application of the theory of relativity, the study of the passage of the electrons through the elements and their transformations, all of this helped listeners to understand the merit of the work by the eminent professor.”[41]

6. (B-bibliography). The fundamental text of 1919 by Sommerfeld[42] was cited in two bibliographical notes published in *Ibérica*, Nº 471, 31 March 1923, p. 208 and Nº 482, 16 June 1923, p. 384, respectively. Specifically, the notes refer to a French translation of the book, divided into several fascicles.[43] The book is described as “an indispensable treatise for all the physical-mathematicians.”[44]

37 [“Modernas teorías sobre las rayas espectrales”].

38 See note 24.

39 Cf. J.M. Sánchez Ron; *Historia de la física cuántica*, Drakontos, Barcelona, 2001; *Miguel Catalán. Su obra y su mundo*; CSIC/Fundación Menéndez Pidal, Madrid, 1994.

40 [1. Fundamentos de la teoría de Bohr, espectro del átomo de Hidrógeno; 2. Estructura fina del espectro del Hidrógeno; 3. Teoría de los espectros de rayos X; 4. Estructura fina de los espectros de los rayos X; 5. Espectros ópticos en general; 6. Complementos matemáticos acerca de las integrales de fase].

41 [“Toda esta materia de la constitución del átomo y de la estructura fina del espectro la tiene el conferenciante magistralmente expuesta en su obra *Atombauund spectrallinien* […]. Sus razonamientos sobre la cuantificación de la energía, la aplicación de la teoría de la relatividad, el estudio del trayecto de los electrones en los elementos y de sus transformaciones, ayudaron a los oyentes a comprender el mérito de los trabajos del eminente profesor”].

42 See footnote 24.

43 A. Sommerfeld, *La constitution de l’atome et les raies spectrales*; trad. H. Bellenot; Librairie A. Blanchard, 3, Place de la Sorbonne; Paris, 1923.

44 [“Un tratado indispensable para todos los físico-matemáticos”].

Finally, in order to illustrate the level of exposure and the according task of propagation performed by the journal, we especially highlight two papers that we consider fundamental to this aim, which were published near the end of the period analyzed:

7. (B-paper). “The structure of matter”[45]; Ernst Rutherford; published in 1924. It contains the opening speech to the assembly of the British Association for the Advancement of Science in Liverpool on 12 September 1923. The article consists of four parts (each of which counts as an entry in the graph):

- Part 1 (*Ibérica*, Nº 357, 19 July 1924, pp. 59-62): The constitution of the atom. The electron. Radioactivity[46]
- Part 2. (*Ibérica*, Nº 542, 6 September 1924, pp. 138-142): The electrical nature of the atom. The atomic number. The Bohr atom[47]
- Part 3. (*Ibérica*, Nº 545, 27 September 1924, pp. 186-189): Different orbits of the planetary electrons. Other aspects of the theory of Bohr. The nucleus of the atom[48]
- Part 4. (*Ibérica*, Nº 551, 8 November 1924, pp. 280-284): Isotopes. The interior of the nucleus. Concentrated energy in the nuclei. Conclusion[49]

The translation of Rutherford's speech was amended by some illustrations taken from contemporary publications (Fig. 4 and 5).[50]

Remarkably, the publication of this large summary started only ten months after the event at which the speech was given; this fact, in addition to the high quality of the summary, are clear signs of the boost physics experienced in Spain through the creation of the previously mentioned Laboratorio de Investigaciones Físicas in 1920.

8. (B-paper). “From the Congress of Coimbra. Summary of opening speech to the section of physical and chemical sciences. The theory of *quanta* and the emission of energy”; Julio Palacios[51]; *Ibérica* Nº 388, 25 July 1925, pp. 77-80). In 1925, Julio Palacios gave an important speech at the opening of the Congress of Coimbra, on the occasion of the inauguration of the section for “physical and chemical sciences” in June 1925; the speech was published only one month later, in one of the last issues of the magazine’s first incarnation. The paper offered an extended summary, which included an outline of the postulates of the Bohr-Sommerfeld model and its application to the study of X-ray spectral series, referring again to the classic book by Sommerfeld, *Atombau und Spektrallinien*; the article ended with a discussion on the theory of *quanta*.

45 [“La estructura de la materia”].

46 [La constitución del átomo. El electrón. La radioactividad.].

47 [Naturaleza eléctrica del átomo. El número atómico. El átomo de Bohr.].

48 [Distintas órbitas de los electrones planetarios. Otros aspectos de la teoría de Bohr. El núcleo del átomo.].

49 [Los Isótopos. Interior del núcleo. Energía concentrada en los núcleos. Conclusión.].

50 I thank Arne Schirrmacher for his identification of Fig. 5 as taken from the book Hendrik A. Kramers/Helge Holst; *The atom and the Bohr theory of its structure, An elementary presentation, with a foreword by Sr. E. Rutherford*, Copenhagen 1923.

51 Julio Palacios Martínez was an important Spanish physicist. His research focused, among other topics, on low-temperature isotherms for the noble gases; the surface tension of mercury; the paramagnetic and diamagnetic substances; the diffraction of X-rays by crystal structures; the theory of relativity, against which he developed a critique in the last stage of his life, postulating a return to classical notions of absolute space and time.

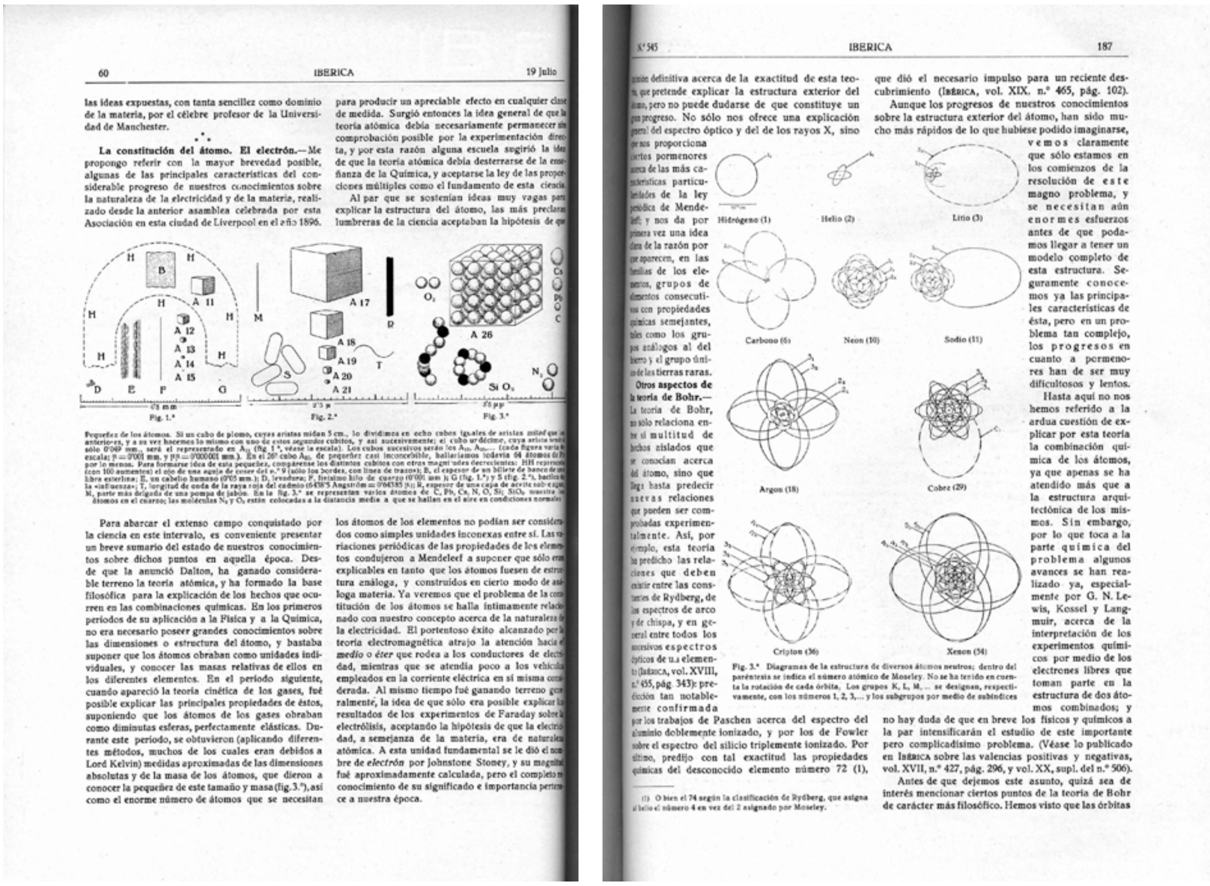


Figure 4 and figure 5: Two pages with illustrations from the paper by Ernst Rutherford

In this way, and in accordance with the proposed aim of spreading scientific knowledge, this great article was a fitting close to the journal's magnificent contribution in its first stage to spreading the new atomic theory in Spain and Latin America. The very same year in which scientists like Bohr, Heisenberg and Schrödinger were leading physics towards a new rigorous quantum formalism, Spanish and Latin Americans lay readers had access to a full description of the Sommerfeld-Bohr model of the atom, the new quanta and their consequences.

Conclusions

The journal *Ibérica* contributed effectively in its first stage (1914-1925) to the spreading of scientific knowledge in Spain and Latin America. The journal was able to present to its readers a valuable account of the new developments in quantum and atomic theories, and this effort was especially intense in the final years of this period. Consequently, its study is imperative to understand the diffusion of the new physical theories in the corresponding society.

Therefore we consider the magazine *Ibérica* to be a fundamental element in the study of the popularization of quantum and atomic physics in Spain. Continuing and deepening the analysis of the journal, including its second stage (1925-1936), will be a powerful tool to study the social diffusion of the new physics in Spain. Additionally, and given the great complexity of the theories involved, this topic is of great interest for understanding some of the conceptual problems associated with the popularization of science in connection with social and cultural contexts. It would be also very convenient to complement this research by looking for other kinds of relevant information, such as the base of subscribers to the magazine and its social distribution, the number of units sold, and the size of the audiences attending the announced lectures and other events.

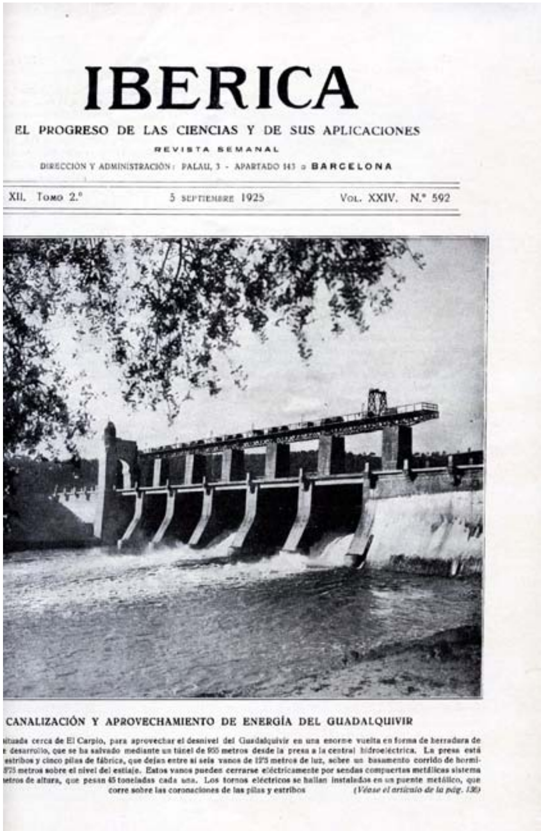


Fig. 6. First issue edited in Barcelona

Fig. 7. First volume of the third stage (2ª época)

20th Century Publishing and Learning Phenomena

The popularization of science in Spain around 1900: New sources, new questions

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Until recent years, the ‘popularization of science and technology’ had been considered a marginal field, focusing on processes of the diffusion of scientific knowledge as a mere complement to studies of the production of ‘science proper’. The focus on countries that have not played a leading role in the emergence of modern science and technology seems to have extended this marginality to the geographies of science and technology. However, writing the history of the popularisation of science and technology from and in the European periphery implies the recovery of an enormous heritage of as yet unknown primary sources.[1]

It is worth remarking that the popularizers described in this paper would never appear in a *Dictionary of Scientific Biography*, and in some cases not even in national biographies and encyclopaedias. Weak institutionalization probably meant a lack of capacity to have a voice in scientific centres, but on the other hand contributed locally to blur the boundaries between expert and lay knowledge, between professionals and amateurs, often creating very fluid channels of communication through society. In spite of the lack of great luminaries, in peripheral contexts such as nineteenth-century Spain, popular science books were successful publishing enterprises and were widely read in public libraries; science and technology related articles were numerous and frequent in the daily press; scientific public lectures were very well attended in cultural societies, athenaeums and working-class organizations; the frontiers between research papers, university textbooks, popular books, exhibitions, and scientific theatres were not particularly well defined. Equally, a clear distinction between popular and educational science books was rare and exceptional.[2]

In the nineteenth century, Spanish science had almost no impact internationally.[3] The liberal revolution of 1868 brought for a short period of time considerable intellectual freedom, but the new Republican regime was feeble and fragile. After the Bourbon Restoration in 1875, the country enjoyed certain political stability, but this was always counterbalanced by frequent

1 For further details on this discussion, see: *Popularizing Science and Technology in the European Periphery, 1800-2000*, eds. Faidra Papanelopoulou, Agustí Nieto-Galan, and Enrique Perdiguero (Aldershot: Ashgate, 2009).

2 There is some parallelism here with Terry Shinn’s and Richard Whitley’s ‘expository science’ model. See: Shinn, Terry and Whitley, Richard (eds), *Expository Science: Forms and Functions of Popularization.* (Dordrecht, 1985).

3 Perhaps with the exception of Santiago Ramón y Cajal (1852-1934), who was awarded the Nobel Prize for Medicine in 1906.

social crisis.[4] In 1898, the loss of Cuba and the Philippines as a consequence of the war against the United States, symbolized the last days of the Old Spanish Empire, and the whole country engaged in intense self-criticism, in search of the causes of the military defeat. The nation's scientific backwardness was often quoted as a decisive reason.[5] Scientific theories such as Darwinism and Thermodynamics often faced theological interferences by the religious authorities, which also had a strong influence on the educational system.[6] Public debates often reflected a negative discourse in which, for a variety of reasons, the country's scientific capacity was called into question.

Strategies for the popularisation of science in late nineteenth-century Spain were shaped by that particular context, and numerous scientific controversies and claims of authority took place in the public sphere rather than in the esoteric academic circles. As a result, as I hope the case studies presented in this paper will illustrate, popularisation practices were frequent and numerous, and the scientific culture of the country grew up stronger than expected in a context of 'backwardness'.

The public scandal of Darwinism: Odón de Buen (1863-1945)

In the 1890s, from his chair of 'Natural History' at the University of Barcelona, Odón de Buen (1863-1945) was deeply committed to Darwinism. He raised bitter criticism from a good number of conservative groups, which perceived evolutionist ideas as a dangerous intellectual weapon in hands of liberal republicans. Jaume Català, the bishop of Barcelona, denounced de Buen's 'illegal' teaching practices, and, as a result, his textbooks were censored and his Zoology course interrupted.[7]

The affair became a real public scandal in Barcelona and reached the central political authorities in Madrid. Students, university professors, intellectuals, and journalists avidly discussed De Buen's attitude, and reflected very well the complex appropriation of Darwinism in late nineteenth-century Spain. After more than two months of public controversies, De Buen was

4 It allowed a 'civil discourse', in Thomas Glick's terms, which in turn favoured the emergence of an active generation of Spanish scientists in the early decades of the twentieth century. Thomas Glick, *Einstein in Spain. Relativity and the recovery of science*. (Princeton: Princeton University Press, 1988), pp. 3-16. However, the 'civil discourse' does not necessarily imply the political 'neutrality' of the scientists

5 Agustí Nieto-Galan, "The images of science in modern Spain. Rethinking the 'polémica', in *The Sciences in the European Periphery during the Enlightenment*, ed. Kostas Gavroglu (Dordrecht: Kluwer Academic Publishers 1998), 65-86; Agustí Nieto-Galan, "The History of Science in Spain: Imperial Past, Peripheries and the Making of the Modern State", *Neusis* 2006, 15:50-74 (in Greek). The English version, which is entitled: "The History of Science in Spain: A critical overview", will appear in *Nuncius* in 2008.

6 Thomas F. Glick (ed.) *The Comparative reception of Darwinism*. (Austin: University of Texas Press, 1974); Thomas F. Glick, Miguel Angel Puig-Samper, Rosaura Ruiz (eds.) *The Reception of Darwinism in the Iberian world: Spain, Spanish America and Brazil*. (Dordrecht: Kluwer, 2001); Stefan Pohl, *La circulación de la energía. Una historia cultural de la termodinámica en la España de la segunda mitad del siglo XIX.* PhD thesis. (Barcelona: Universitat Autònoma de Barcelona, 2007); Stefan Pohl, "The Circulation of Energy: Thermodynamics, National Culture, and Social Progress in Spain, 1868-1890" in *Popularizing Science and Technology in the European Periphery, 1800-2000*, eds. Faidra Papanelopoulou, Agustí Nieto-Galan and Enrique Perdiguero (Aldershot: Ashgate, 2009), .

7 Josep Arqués, *Cinc estudis històrics sobre la Universitat de Barcelona (1875-1895).* Columna. Barcelona, 1985, pp. 21-66. See also: Agustí Nieto-Galan, "El llibre de divulgació científica: autors, editorials, públics", in Pilar Vélez (eds.) *L'exaltació del llibre al Vuitcents. Art, indústria i consum a Barcelona*. Biblioteca de Catalunya. Ajuntament de Barcelona. Barcelona 2008, 201-220.

allowed to continue with his regular teaching activity at the University. As a result, he became a very active propagandist of evolutionism. He regularly gave public lectures in workers' associations, and in primary and secondary schools; he published new natural history popular books, and favoured a positivistic approach to natural history. He efficiently contributed to the popularisation of a positive science, which acted as an intellectual weapon against the Catholic Church, in the context of the polarised tension between science and religion in late nineteenth-century Spain.

In 1890, De Buen published his *Tratado elemental de Zoología*, the second volume of his academic textbook entitled *Curso completo de Historia Natural*.[8] A year later, in 1891, De Buen started his publishing adventure with the firm Montaner y Simón. His *Historia Natural* appeared within the series "Biblioteca científica'.[9] The selling figures ranged from 10,000 to 20,000 copies, compared with the 30,000 sold by the *Historia general del Arte*, and the 400.000 of the *Diccionario Enciclopédico Hispano Americano*.[10] De Buen also wrote a new version of his *Historia Natural* but this time addressed to the lower classes.[11] It appeared in 1896 under the title *Historia Natural (edición popular, con profusión de grabados)* [popular edition with a rich collection of engravings], in two volumes published by Manuel Soler. The book was to contribute to his anticlerical campaign in favour of Darwinism. In his own words:[12]

> "I have quickly published this popular version, on which I have been working for a long time, as a response to the requirements of the public opinion. After being censored by the Church, I wanted my work to be known. My purpose was to spread the positive science to the heart of the people".

Just a year after the public scandal with his chair, De Buen's views reflected the weakness of the Spanish scientific culture at the end of the century. He defended the priority of popularisation in relation to research and university teaching. This aim was at the heart of the *Manuales Soler* project, which was addressed to the following audiences:[13]

> "to fans of education, to men of science, politicians, professionals, as well as individuals who cultivate their intelligence in the arts, the sciences, industries and practical applications; to families wanting to promote a love of learning in their homes ; to scientific, political, professional, and leisure centres and associations, for the intellectual improvement of their members…".

But De Buen's *Historia Natural* achieved further expository levels. He worked on close collaboration with the *Escuela Moderna*, an educational project of the freethinker and intellectual Francesc Ferrer i Guàrdia (1859- 1909), who asked De Buen to write a set of pamphlets (*car-*

8 Odón de Buen, *Tratado elemental de Zoología. Curso completo de Historia Natural. Segunda parte*. La Academia Barcelona, 1890

9 "Colección de obras de investigación y divulgación por eminentes especialistas españoles y extranjeros", Odón de Buen, *Historia Natural*. 13 vols. Montaner y Simón 1891-1895; 1. Antropología, P. Topinard. 2-7. Zoología, C. Claus. 8-11. Botánica y Geografía botánica, Odón de Buen. 12. Mineralogía, Gustavo Tschermak. Geología, Archibaldo Geikie. 13. Geología, Archibaldo Geikie.

10 Montaner y Simón. Caixa II. 1902. Fons Borràs. Biblioteca de Catalunya. Barcelona.

11 Odón de Buen, *Historia Natural (edición popular, con profusión de grabados)*. 2 vols. Manuel Soler. Barcelona 1896

12 Odón de Buen, *Historia Natural (edición popular, con profusión de grabados),* op. cit., p. xvii,

13 Ibidem, contraportada.

tillas didácticas) under the title: *Las Ciencias Naturales en la Escuela Moderna*.[14] De Buen also published *Las Ciencias naturales en la época moderna* with Maucci, a publishing house of Italian origin that specialized in cheap popular books and pamphlets.[15] He had been also engaged in an ambitious cultural project of an open university (*extensión universitaria*) to spread science beyond the walls of the academia through itinerant lectures in cultural societies, and workers' organizations.[16] From his academic publications (university textbooks and research papers) to the simplest leaflets, De Buen experienced a huge range of literary levels for the spreading of the natural sciences to all publics.

Popular astronomy as a tool against scientific backwardness: Josep Comas Solá (1868-1937)

Josep Comas Solà did not hold a university position, but in 1911 he founded the so-called *Sociedad Astronómica de España y América* (SADEYA).[17] From 1904 to his death in 1937, Comas became the director of the *Observatorio Fabra*, a private astronomical observatory, from which he built a research team, and established scientific relations with prestigious astronomical observatories abroad such as Lick, Yerkes, Meudon, and Potsdam. He was an active science popularizer with more than thousand articles in the widely-read newspaper *La Vanguardia* – a good number of them, devoted to astronomy. Mainly university professors and directors of astronomical observatories, but also businessmen and opticians, constituted the governing body of the *RSDAEYA,* which had three sections addressing the general public: popularization of astronomy; elementary descriptions of planets and stars; and obituaries of famous astronomers.[18]

In the late nineteenth century, Spain had a good number of private and public observatories, but only a small number of individuals were able to develop a professional career. In Universities, astronomy was only taught in some chairs of cosmography, physics of the Earth. Few faculties had telescopes, and those that did were used mainly for didactical purposes.[19] Expertise and astronomical knowledge was not necessarily linked to professionalization. Although some academics defended expert control, in practice, the leadership of popular astronomy was mainly in hands of amateurs. In fact, in contexts of weak professionalization such as nine-

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14 Odón de Buen, *Mis Memorias (Zuera 1863 – Toulouse 1939).* Institución Fenrando el Católico (CSIC). Excma. Diputación de Zaragoza. Zaragoza 2003, p. 96.

15 Odón de Buen, *Las Ciencias naturales en la época moderna. por Odón de Buén, Doctor en Ciencias naturales y catedrático de las asignaturas de Historia Natural de la Universidad de Barcelona. Pequeña Historia Natural. Primera parte (Geología y Botánica)*. Casa Editorial Maucci. Barcelona s.a. [ca. 1913], 5 vols. 1. Geología y botánica. 2. Zoología. 3. Mineralogía. 4. Petrografía. 5. Edades de la Tierra.

16 Odón de Buen, *Mis Memorias.* op. cit. , p. 60.

17 On Comas Solà see: Francesc Xavier Barca, "Josep Comas i Solà: l'astronomia de posició", in *Ciència i Tècnica a l'època contemporània als Països Catalans,* II, 795-825; Antoni Roca-Rosell (ed.) *Josep Comas i Solà. Astrònom y divulgador.* (Barcelona: Ajuntament de Barcelona, 2004); Pedro Ruiz Castell, *Astronomy and astrophysics in Spain (1850-1914)* (Newcastle: Cambridge Scholar Press, 2008).

18 *Revista de la Sociedad Astronómica de España y América. Información general de astronomía, geofísica, meteorología y demás ciencias afines. Publicación mensual ilustrada. Órgano de la Sociedad Astronómica de España y América*

19 Pedro Ruiz Castell, *Astronomy and Astrophysics.* op. cit.

teenth-century Spain, amateur astronomers probably played a more important role than in well-established scientific communities.[20]

For his astronomical project, Comas used Camille Flammarion's model, and regularly published his observations in *L'Astronomie*, the journal of the *Société Astronomique de France*, which enjoyed great success in the last decades of the nineteenth century. Comas vigorously defended the need to spread popular astronomy as a necessary requirement for the intellectual stimulus of the population. However, he critically appropriated some aspects of Flammarion's legacy.

In 1906, Comas translated Camille Flammarion's *Astronomie populaire* (1880), but adapted the text with the introduction of his own instruments as well as photographs of eclipses from his own collection. In spite of his close contact during the 1905 visit, Comas was not enthusiastic about Flammarion's faith in "Spiritism". In 1908, he published *El espriritismo ante la ciencia*, showing a sceptical attitude towards such contemporary fashionable practice.[21]

In Comas's view, it was 'rational scientific objectivity' that had to be imported from abroad but not the kind of pseudoscientific practices that could, in the end, weaken the already feeble scientific culture of the local context even further. Comas perceived popularisation as a fundamental tool to strengthen the scientific culture of the country. In the aforementioned context of scientific backwardness, popular astronomy was addressed to a public, which, in the late nineteenth century and the early twentieth century, had significantly lost its confidence in the scientific capabilities of the country.[22] It was perceived as a useful tool to raise the scientific level of the population, to stimulate young people to take the road of science and its values. In Comas's view, spreading astronomy was a way to catalyze a more dynamic scientific culture in a society that perceived itself as backward in terms of international science. Popular astronomy supposed to enlighten the possible limits of our cosmos; to encourage the general instruction on useful knowledge, and to stimulate the habits of calculation and observation. In his own words:[23]

> "I feel myself dutybound to denounce the extraordinary scientific backwardness of our country, in order to encourage a better esteem for culture and the love for science".

20 Perhaps with the exception of Victorian Britain, this statement can be generalized. For the history of amateur astronomy in Spain, see: Josep Maria Oliver, *Historia de la astronomía amateur en España*. See also:, Alan Chapman, *The Victorian amateur astronomer: independent astronomical research in Britain, 1820-1920*. (Chichester: J. Wiley, 1998)

21 Camille Flammarion, *Astronomia popular (modernizada por José Comas Solá). Director del Observatorio astronómico del Tibidabo (Barcelona). Edición ilustrada con 109 grabados*. (Barcelona: Biblioteca de Enseñanza popular. F. Granada, 1906)

22 "....ese gran público que, por desgracia, ha perdido la fe en el valor científico de España", *BSAB*, I, 1910-12, p. 1.

23 "Me he creído también en el deber de poner de relieve el extraordinario atraso científico de nuestro país, al objeto de exaltar el sentimiento de la cultura y el amor a la ciencia", José Comas, *Astronomía y Ciencia General. Colección de trabajos científicos de popularización referentes a la astronomía, a la sismología, a a historia de la ciencia en el siglo XIX, etc*. (Barcelona: F. Granada y Cia., 1907), p. viii. For Flammarion's influence in Comas, see: Ignasi Cebrian, "Divulgador i periodista científic", in *Josep Comas i Solà. Astrònom y divulgador.* pp. 131-159. See also: Agustí Nieto-Galan, "The images of science in modern Spain", op. cit.

In spite of his numerous local disputes for priority on several observations and also for the leadership of astronomy in the local context, particularly in the city of Barcelona, Comas's rhetoric was clearly embedded with an obsession; that is to say: spreading astronomy in its 'popular' form was a top priority for the improvement of the scientific level of the country. Popular science had to be spread first, later would come standard, research-oriented, high-level scientific culture.[24]

Legitimizing thermodynamics in a hostile local context: José Echegaray and others[25]

In the final decades of the nineteenth century, several Spanish University professors were keen to popularize different aspects of Thermodynamics. The most famous trio, José Echegaray (1832-1916), Gumersindo Vicuña (1840-1890) and Francisco de Rojas (1832-1909) used popular Thermodynamics as a key legitimating element for the institutionalization of mathematical physics in Spanish universities.[26] In the 1870s, these three engineers, were the first holders of chairs of mathematical physics, and soon became local authorities on Thermodynamics.[27] In a very weak University system, and in the framework of Science Faculties, which were often only considered as a preparatory level to pursue further studies in Engineering, any approach to basic theoretical physics – 'pure physics'– was traditionally considered irrelevant by the academic authorities. Abstract discussions about the unity of physical forces, or the mechanical explanations of heat, light, electricity or magnetism seemed relegated to a marginal position.

Through his popular books on Thermodynamics, the three engineers defended the need to cultivate high level pure physics, for the solid scientific training of the young generations, but also as a strategy of national prestige, in a country that suffered from severe scientific backwardness. Therefore, in their views, scientific and economic progress was only possible through a unified corpus of physical knowledge, in which thermodynamics had a very important role to play. As a result the popularisation of thermodynamics through publications such as *Teorías modernas de la física [Modern physical theories]* (Echegaray, 1873), *Teoría y cálculo de las máquinas de vapor y gas con arreglo a la termodinámica [Theory and calculations on steam and gas engines according to Thermodynamics]* (Vicuña, 1872), and *Termodinámica. Su historia, sus aplicaciones y su importancia [Thermodynamics. Its history, its applications*

24 For the controversy between defenders of popular science and those in favour of the promotion of high level academic research, see: Mònica Baró and Teresa Mañà, "Eugeni d'Ors i les biblioteques", *Textos universitaris de biblioteconomia i documentació,* 2004, 12, 1-19. See also my: " ' … not fundamental in a state of full *civilization'*. Popular astronomies in Barcelona in the early twentieth century" (submitted for publication to *Isis*, 2008).

25 In this section, I mainly sumarize Stefan Pohl's doctoral research, under my supervision at the Universitat Autònoma de Barcelona. See: Stefan Pohl Valero, *La circulación de la energía.* op. cit.

26 See Stefan Pohl Valero, 'La termodinámica como elemento legitimador de la física teórica y aplicada en la España de la segunda mitad del siglo XIX', *Quaderns D'Història de L'Enginyeria*, 7 (2006): 73-114.

27 See especially, José Echegaray, *Tratado elemental de termodinámica* (Madrid, 1868); José Echegaray, *Teorías modernas de la física. Unidad de las fuerzas materiales* (2nd ed., Madrid, 1873); Gumersindo Vicuña, *Teoría y cálculo de las máquinas de vapor y gas con arreglo a la termodinámica* (Madrid, 1872); Gumersindo Vicuña, *Elementos de física al alcance de todo el mundo* (Madrid, 1874); Gumersindo Vicuña, *Manual de física popular* (Madrid, 1878); Francisco Rojas, *Termodinámica. Su historia, sus aplicaciones y su importancia* (Barcelona, 1876); Francisco Rojas, *El problema físico y el problema químico se resolverán en el mecánico. Memoria presentada ante la Real Academia de Ciencias de Barcelona* (Barcelona, 1877).

and its importance] (Rojas, 1876) became crucial for the legitimization of a new academic discipline, which was labelled at that time as mathematical physics.

But there were other complementary strategies. In a country with a longstanding tradition of influence of a powerful Catholic Church, claims that Thermodynamics did not jeopardize basic Christian values such as God, free will, and the immortality of the soul were very common in popular accounts. They strengthened the idea that scientific materialism was the key explanation of the real cause of social instability. Equally, energy conservation could be used to reinforce the idea of the existence of God and the immortality of the soul.

Ludwick Büchner's famous book *Kraft und Stoff* (1855) was translated into Spanish just after the liberal revolution of 1868, in a period of intellectual openness and considerable freedom of press.[28] Stressing that matter and force were inseparable concepts supporting the idea of an eternal and cyclical universe, Büchner rejected the existence of God.[29] Similarly, William Draper's *History of the Conflict between Religion and Science* (1874) was translated into Spanish in 1876, and strongly criticized Catholicism.[30] John Tyndall's and Ernst Haeckel's popular texts also used energy conservation as one of the principle scientific arguments to question traditional religious values, and they were widely read and discussed in Spain.[31]

As a reaction, several books and articles rejected scientific materialism.[32] In the 1870s, conservative and catholic journals such as *La defensa de la sociedad*, or *La ciencia cristiana* paid special attention to the dangers of materialism in scientific theories. They emphasized that 'real science' could not reject God and stressed the dangers of an eternal and mechanical universe. They portrayed scientific materialism as a common social threat that had to be fought. Science was presented as a key element for the progress of civilisation; however, the absolute centrality of moral progress was also emphasised. Based on the ontological interpretation of energy, they stressed that modern physics was in perfect harmony with religion. This was especially against Büchner's idea of an eternal and self-regulated universe.

In that context of double hostility – a weak academic system and a powerful Catholic influence - Echegaray, Vicuña and Rojas 'translated' theories and ideas from Northern Europe to allow them to properly fit within the power relations and cultural constraints of later nineteenth-century Spain. The introduction of Thermodynamics in education and popularisation was perceived by the Spanish elites as a necessary step for scientific modernisation. However, for its legitimization in the local context Thermodynamics had to be separated from materialism. Then the path was open for its public acceptance. The conquest of the local public arena was again crucial for the legitimization of the new science of heat.

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28 Ludwig Büchner, *Fuerza y materia. Estudios populares de historia y filosofía naturales* (Madrid, 1868).

29 For Büchner's materialism, see Frederick Gregory, *Scientific Materialism in Nineteenth-Century Germany* (Dordrecht, 1977).

30 John William Draper, *Historia de los conflictos entre la religión y la ciencia* (Madrid, 1876).

31 See: John Tyndall, "La evolución histórica de las ideas científicas", *Revista Europea*, 2 (1874): 469-476, 500-513. Ernst Haeckel, "Teoría evolutiva del universo y de la tierra", *Revista Europea*, 12 (1878): 392-399.

32 Zeferino González, *El positivismo materialista* (Madrid, 1872); Francisco Caminero, 'El doctor Büchner o el catecismo de los materialistas', *La Defensa de la Sociedad*, 4 (1873-74): 439-451; Antonio María Fabié, *Examen del materialismo moderno*, (Madrid, 1875). I am indebted to Stefan Pohl for these references.

Conclusion

What kind of lessons can be learn through the analysis of De Buen, Comas, and the Thermodynamics trio, in terms of specific features of the popularisation of science in later nineteenth-century Spain? Local professional scientists – Comas being the only exception- became popularizers, and constituted the main group of authors. Holding posts as university professors, they often complemented their low salaries with scientific articles and books for a wide range of readers. Their textbooks often became at the same time popular books of natural history, astronomy, and thermodynamics.

The absence of great luminaries was counterbalanced by a broad scientific culture, in which amateurs also played a very significant role. In that context, the 'populariser' was not easily distinguished from the 'scholar-scientist' or even the 'science teacher'. Boundaries between expert and lay knowledge, between professional and amateur science, were very loose and not well defined. In a context of weak professionalization, popular science and technology had a very prominent place among middle classes, and even among lower classes.

In the final decades of the nineteenth century, the publishing market grew substantially. As we have seen especially in De Buen's case, popularizers engaged in ambitious projects, including textbooks, encyclopaedias, series of the 'science for all' type, aimed at the Spanish and the Latin-American markets. Montaner y Simón sold luxury and prestigious encyclopaedias, whereas Manuales Soler and Maucci invested in a more 'popular', cheaper science range. Reading figures were considerable. The wide circulation of popular books, articles, lectures and exhibitions across the Spanish society enriched a scientific culture that enjoyed notable independence from the great names of the 'universal science'.

Controversial concepts such as natural selection, the plurality of worlds, energy, were frequently discussed in popular texts, but they were often adapted to the specificities of the Spanish context: the strong influence of the Catholic Church, the longstanding public debate on the scientific backwardness of the nation, and the weaknesses of the academic system. Popular accounts on Thermodynamics aimed to find a balance with religion, but in other cases – such as De Buen's Darwinism – popular natural history was used as a tool to spread secular positivism with anticlerical overtones. Popular astronomy, in Comas's view, was a reaction against pessimism, a sort of intellectual seed for the young generations to overcome the scientific backwardness of the country. It reinforced the rhetoric for the modernisation of the nation through science and technology.

Perhaps the history of science and technology in nineteenth century Spain is mainly the history of the communication practices – teaching and popularisation – of local experts, who critically appropriated the great names and ideas from the centres, communicated their knowledge through local publishers in their local contexts, and constituted the main primary sources for science and technology. This paper is only a very modest attempt to recover the enormous number of Spanish primary sources which still deserve further attention.[33]

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33 See: *Popularizing Science and Technology in the European Periphery,* note 1.

New Initiatives in Popular Science Publishing in Early Twentieth-Century Britain

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This short account summarizes research published in Bowler (2006) and more extensively in a recently-published book (Bowler, 2009). The main focus is on a particular type of literature aimed at bringing information about science to the general public in the early decades of the twentieth century. This is what may be called 'self-education' literature, which appeared mainly in the form of book series and serial works (the latter usually issues in magazine format in fortnightly parts). The material was aimed at a very specific audience, those members of the working and lower middle classes who were hoping to 'improve themselves' though informal education. These people would have had some secondary education but little hope of going on to college or university, so they had to study informally or through various types of evening classes and reading groups organized by institutions such as the Workers' Educational Association. This audience was looking for authoritative information conveyed by experts – it was thus perhaps more passive than we might expect, given the recent criticism by modern scholars of the 'standard model' of science popularization. Here there really was a one-way flow of information and comments from experts to public – although where there were disputes among the professionals the rival interpretations could be projected to the public through this medium. But the potential readers were not formal students and wanted their information packaged in a relatively easy-to-read format. Publishers were commercial concerns and needed to sell books, so the scientists who wanted to become authors had to learn how to present their material in an attractive way.

In the years immediately before the outbreak of the Great War, a number of publishers responded to what they claimed was a growing demand for authoritative information about academic and scientific topics, conveyed in an attractive way that could be absorbed by readers with little existing knowledge. They argued that the great publishing initiatives of the Victorian period had now become outdated, just as there was an increasing demand from readers who now had some basic education and a desire to improve their knowledge of the world (perhaps in the hope of getting a better job). There was indeed a steady improvement in the level of secondary education following the Education Act of 1902, but no equivalent expansion of tertiary education. Science would form a large part of the material covered, given its increasing role as a factor in industrial development – everyone, it was argued, now needed to be 'up to date' in this area.

To satisfy this demand, publishers sought experts who could write texts that would convince the public that they were getting authoritative information. This gave working scientists and those with academic qualifications in science the opportunity to address a non-specialist audience. Contrary to the assumption that the newly professionalized scientific community soon turned its back on popular writing, a significant number of working scientists tried their hand at this kind of writing in the period up to 1950 (for a list of authors with short biographies see www.press.uchicago.edu/books/bowler). Some wrote only a few such texts, but a few became expert communicators and authored numerous books and contributions to serial works. The publishers were anxious to encourage those experts who could acquire the skill of conveying information (without too much mathematics or technical terminology) to the general public. Some scientists became household names because they published so prolifically, a good example being J. Arthur Thomson, professor of natural history at the University of Aberdeen (Bowler, 2005). Thomson more or less gave up his research to write popular literature, and was occasionally criticized for this by his fellow scientists. But because the texts were mostly of an educational nature, scientists who kept up their research while pursuing a writing career on the side were seldom marginalized by their peers. (Those who wrote more sensationalized material for newspapers and magazines, however, did encounter criticism, as in the case of Julian Huxley). A small number of writers with limited technical education did gain a reputation as experts through their writing, e.g. Charles R. Gibson and Ellison Hawks, although these were usually individuals with at least some contacts with the scientific and technical communities.

Gibson and Hawks concentrated on fairly expensive books which sold as school prizes or Christmas or birthday presents for middle-class boys (although they were probably also read by the boys' fathers). The publisher Seeley, Service & Co. specialized in book series aimed at this audience. But the most active area of self-education publication was the issuing of series of books intended to supplement a secondary education for adults who could not expect to enter further education. Some series were exclusively scientific, but many offered education across the whole academic spectrum. These books had to be cheaply produced because the public at which they were aimed would find anything priced much above 6 pence or one shilling too expensive. Publishers advertised their series widely and sent out salesmen to promote them through bookshops. They were very territorial about their markets, and at one point the firm of Williams and Norgate threatened legal action against their rival Jack's because it thought the latter's People's Books series had been deliberately aimed at the same audience as its Home University Library. At least eighteen of these series were launched in the years immediately before the outbreak of the Great War (for a list of series and the scientific titles they contained see www.press.uchicago.edu/books/bowler). The most substantial included the two mentioned above, along with Cambridge University Press's Manuals of Science and Literature, each of which eventually contained several dozen titles on scientific topics. The Home University Library (of which J. Arthur Thomson was the scientific editor) was the only one to continue expanding after the war, but new series were founded in the 1920s, most notably Benn's Sixpenny Library, which pioneered the format of short paperback books. This idea was taken up even more successfully when Penguin Books launched its non-fiction Pelican series in 1937. After a rather limited start, at least in the area of science, the Pelican series expanded rapidly in the 1940s and 1950s and was the last great success story of this self-education format.

Fig. 1: Advertisement for the Home University Library series

Another successful format for self-educational material consisted of serial works issued in a magazine-like format, usually on a fortnightly basis, which would accumulate over a year or so to give an encyclopaedic coverage of a particular topic. Issued at a price of 6 pence or a shilling, these were also cheap enough to be bought by people with limited means. But they were better illustrated than the self-education books, increasingly with photographs as printing techniques improved. They were often issued by the publishers of magazines and newspapers, and were widely advertised by this means. The individual parts could be bound up into book-length volumes, and the works were usually reissued later in that format. The *Harmsworth Popular Science* series of 1911-12, issued by Alfred Harmsworth's (Lord Northcliffe's) Amagalmated Press was given a full front-page advertisement in the *Daily Mail* on the day it was launched. H. G. Wells' hugely successful *Outline of History* of1921 (which had an introductory section on evolution written in collaboration with the zoologist E. Ray Lankester) was originally issued in serial format by George Newnes, the publisher of *Tit-Bits*. Wells subsequently co-authored a sequel, *The Science of Life*, with Julian Huxley, also issued originally in serial format. J. Arthur Thomson also wrote or edited a number of serial works, including his *New Natural History* and *The Outline of Science*.

Most of the self-education books and serials were written by, or included material by, working scientists. As noted above, there seems to have been little opposition by the scientific community to those professionals who spent a limited amount of their time writing this kind of literature. Many of those who participated had a genuine desire to help provide some form of education for those too poor to have any chance of a college or university education. But there were also tensions within the scientific community which were reflected in the arena of popular writing. Thomson was an exponent of a neo-vitalist biology and an almost teleological evolutionism, and this was reflected in his popular writings. He commissioned the neo-Lamarckian embryologist E. W. MacBride to write a text in the Home University Library. But Lankester and Huxley were Darwinians who sought to promote a more materialistic view of biology through their own popular works. Thomson was well aware that his viewpoint was increasingly out of touch with the ideas of the younger generation of scientists, but thought that it was important for the public to know that a less-materialistic alternative was available. This situation led to changes from noted materialists such as Joseph McCabe that an older generation of scientists was using its authority to mislead the public into believing that outdated ideas were still part of contemporary science.

It is also worth noting that there was another significant factor encouraging scientists to write popular material. In a period when professional salaries for scientists were notoriously low, a significant addition to one's income could be derived from royalties and author's fees. The Home University Library paid an advance of £50 for a volume, at a time when many scientists would have been earning only a couple of hundred pounds a year. For anyone who learnt how to write fluently, the rewards could be substantial.

Self-education literature continued to be published successfully through the inter-war years. But the nature of popular science publishing changed in the 1950s and 1960s, marked by the rise and fall of the Pelican series mentioned above. The change seems to have reflected new trends in popular entertainment, especially the coming of television, coupled with the disappearance of the very specific audience at which self-education books were aimed. More children from poorer backgrounds could now go on to university or college education, so they needed real textbooks, not the kind of hybrid that had tried to combine informal education with entertainment. The rather poorly printed and illustrated format still employed by Pelicans was no longer attractive to any but a small cohort of readers. But the disappearance of the self-education series also marked a change in scientists' attitudes toward non-specialist writing. Many of them had been successful in this format, since it did not require them to sensationalize or trivialize their message. But as the public lost interest at this level, popular science increasingly had to reach out to a wider audience, and here scientists felt less comfortable. This was the era when the professional science writer came into his or her own, with all the consequences that have led to the scientific community's current concerns about its relationship to the public.

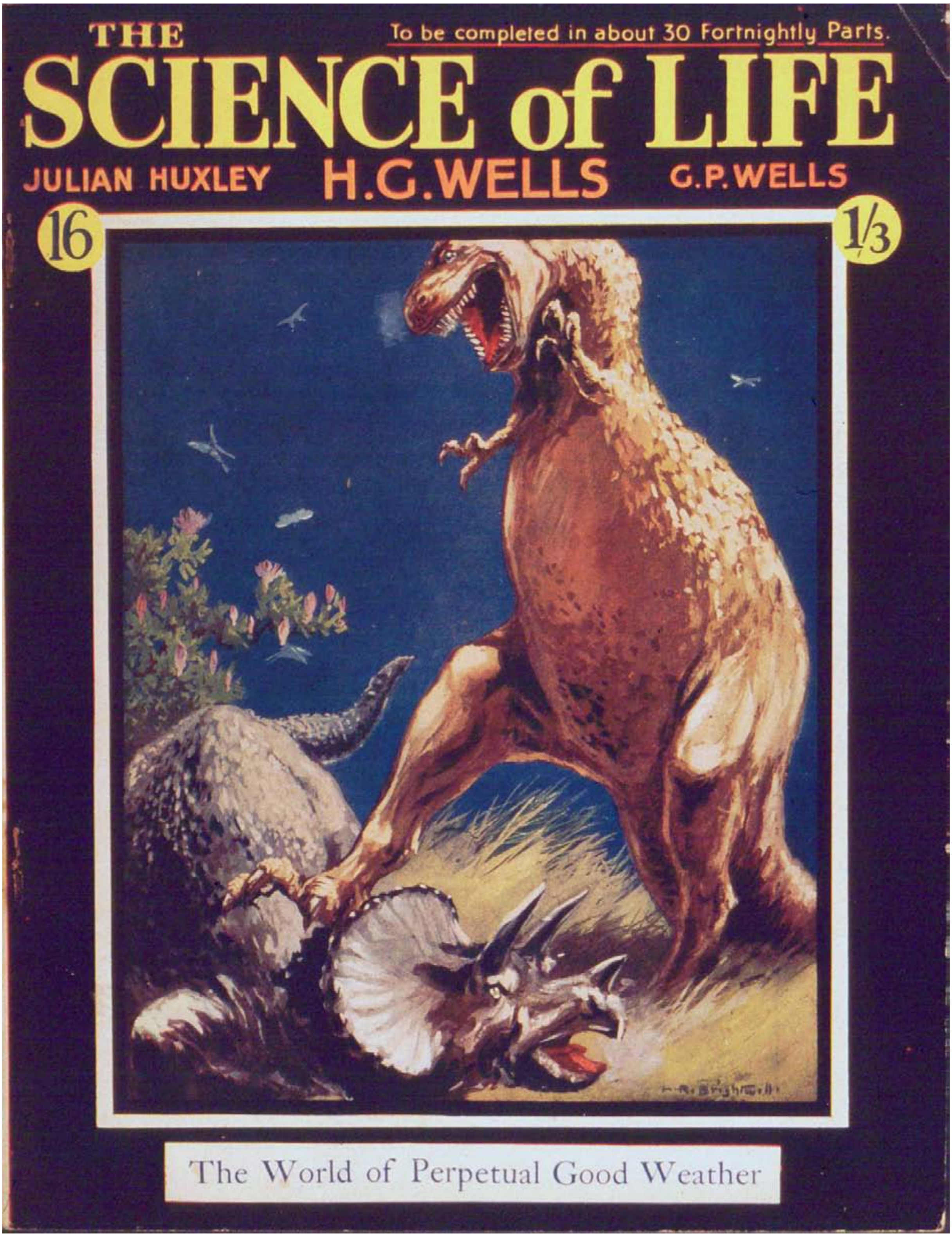

Fig. 1: Cover of "Sciene of Life" by H. G. Wells, Julian S. Huxley and G.P. Wells.
(First issued in 31 fortnightly parts published by Amalgamated Press, 1929-30, bound up in three volumes as publication proceeded. First issued in one volume by Cassell in 1931, reprinted 1934, 1937, popular edition, fully revised, and 1938. Published as separate volumes by Cassell 1934-1937.)

In conclusion, it is instructive to compare the large number of book series and serial works published in the period 1910-1945 with the difficulties faced by popular science magazines in the same period. The Victorian popular science magazines, including the long-running *Knowledge*, all disappeared during the Great War. Three replacements were founded in the inter-war years, but none were very successful. *Discovery* was established in 1920 as an organ of the scientific and academic communities. Most of the scientific and technical articles were written by professional scientists, with some effort to match the popular style of writing used in serial works. Although the magazine survived until the early years of World War II (and was reconfigured a few years later) its last pre-war editor, C. P. Snow, revealed that it had never had enough readers to make a profit and had been maintained by the publisher as a public duty (it may also have been a tax write-off). A more popular magazine, *Conquest*, had been founded in 1919. It had some articles by professional scientists, but many by authors with no technical qualifications, and contained a high proportion of material on applied science, often somewhat trivialized. Despite the effort to reach a wider audience, it lasted only until 1927 when it was absorbed by *Discovery*. A new venture was founded in 1929 with an even more deliberate policy of reaching the 'man in the street.' This was *Armchair Science*, edited by 'Professor' A. M.Low (who was actually an inventor and popular science writer). Low deliberately did not use material written by professional scientists, arguing that they did not know how to write for the ordinary reader. Yet again the magazine struggled to maintain a sufficient readership to be commercially viable: it became steadily more sensationalist in tone, went through several changes in format, and closed in the early years of the war. Curiously, it was not until 1957 – by which time the self-education book series were in decline – that a successful formula for a popular science magazine was achieved with the founding of *New Scientist*.

Why were the magazines so much less successful than the books and serials during the inter-war years? Part of the problem was the need to provide both popular accounts of existing science along with the latest 'science news' – the two areas are not completely distinct, but neither are they identical. The magazines also tended to 'fall between two stools,' as C. P. Snow himself noted when *Discovery* temporarily closed down. If they tried to attract a wide readership, they became too trivialized for the reader looking for more serious information. But if, like *Discovery*, they focussed on readers with a pre-existing interest in science, there were apparently not enough people willing to subscribe on an ongoing basis. Readers looking for self-education seem to have preferred the more encylopaedic information offered by the serials (which were issued in a very similar physical format to the magazines). The success of the later *New Scientist* may reflect an expansion in the audience for a magazine of serious but attractively presented science news in the second half of the twentieth century.

Suggested Reading

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Teaching and Learning Science in Hungary: Schools, Personalities, Influences 1867-1945 *

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I The Making of Modern Hungarian Mind

The emergence of the relatively large number of excellent mathematicians and scientists in Hungary rising at the turn of the 19th and 20th centuries was often explained in very different terms.* The Hungarian-American mathematician George Pólya (1887-1985) answered, "[a] general reason is that mathematics is the cheapest science."[1]

This was, indeed, important in a relatively underdeveloped country. As to specific reasons, Pólya listed the *Középiskolai Mathematikai Lapok* [High School Papers in Mathematics], the Eötvös Competition, and the personality of the mathematician Lipót Fejér (1880-1959). To all this we may add a number of social factors such as Hungarian creativity, the Liberal nature of Hungarian politics during much of the era of the Austro-Hungarian Monarchy, and massive German influence.

Hungarian Creativity

The social history of the Hungarian cast of mind—indeed the way of thinking across much of East-Central Europe—is deeply rooted in war and conflict, abetted by a foe of an entirely different nature: poverty.

This blend of national quirks has made problem solving a natural, permeating all aspects of life, from the most mundane to the highly abstruse. Much of this came from the multiethnic, multicultural, multilingual nature of Hungarian and Austro-Hungarian society, which constantly provided problems to be solved—economic, social, political, and cultural. Hungarians have been ready to accept whatever solutions they could find or devise, even if that has meant flying in the face of received yardsticks or devising new, unorthodox approaches—provided,

* This article has partially drawn upon the author's 2007 Budapest ICAS/POAK conference paper (unpublished), his 2007 von Neumann lecture at Princeton University (distributed as a MS), his 2008 San Marino Euresis symposium lecture (forthcoming), as well as his recently published book, Tibor Frank, Double Exile: Migrations of Jewish-Hungarian Professionals through Germany to the United States, 1919-1945 (Oxford: Peter Lang, 2009).

1 George Pólya interviewed by Agnes Arvai Wieschenberg, „Identification and Development of the Mathematically Talented–The Hungarian Experience," PhD Dissertation, Columbia University, 1984, pp. 86-87.

of course, that these served their purpose. One may conjecture that this call for problem solvers goes part way to explaining the country's longstanding abundance of brilliant mathematicians and scientists, to mention János Bolyai (1802-1860), Lipót Fejér, John von Neumann (1903-1957), George Pólya, and Paul Erdős (1913-1996) as merely the best-known of outstanding talents which spill over, beyond the realm of pure mathematics, into physics, chemistry, engineering, and many other fields.

A potent factor in maintaining that record of achievement lay in the manner secondary schooling was reorganized after the Austro-Hungarian Compromise of 1867. In 1870-72, the educationist Mór Kármán (1843-1915), father of aviation pioneer Theodore von Kármán (1881-1963), was commissioned by the Minister of Religion and Education Baron József Eötvös (1813-1871), to undertake a first-hand study of Germany's acclaimed high-school system. This laid the ground for ensuring that the best Hungarian schools consistently had access to first-class teaching resources capable of encouraging students to standards of attainment that compare favorably with many (and not just lower-tier) colleges in the United States today. On the German model, the high school, or *Gymnasium*, placed heavy emphasis on the Classics, Hungarian language and literature, and universal culture, without neglecting mathematics and the natural sciences. These were unashamedly elitist institutions, with a student intake drawn typically from a rather narrow upper-middle section of Hungary's then still relatively conservative, even feudal society. However, they could attract teaching staff of a very high caliber; many of them recognized scientists and scholars in their own fields, as reflected in their subsequent membership of the Hungarian Academy of Sciences and appointment to university professorships. As a result, the country's top schools, such as the Lutheran high school in Pest or the *Mintagimnázium* (The 'Model') of the University of Budapest, succeeded for several decades in cultivating an astonishingly consistent succession of brilliant young minds, of whom John von Neumann, Eugene Wigner (1902-1995), Edward Teller (1908-2003), and Theodore von Kármán, were only a few of the more prominent, many of whom ended up in the United States.

Of course, there was also animosity to innovation: Conservatism prevailed in much of the Austro-Hungarian Monarchy. Although Hungary was in several ways an ideal creative spawning ground, many of its achievements were made in the face of official Austrian and Hungarian disapproval. For the greater part of the 19th century the national tradition was conservative and the mentality hostile to innovation—not least due to the obverse side of German and Austrian culture, with its authoritarian insistence on strict and often antiquated rules and standards, established patterns of thinking, and unalterable methods. The general ambiance favored preserving the *status quo* rather than supporting new ideas, and accordingly the ruling conservative forces of the pre-1867 period ignored or spurned many reform-minded Hungarians, which more often than not led to exile, the lunatic asylum or to suicide. There is of course a contradiction here between conservatism and renewal, which was seen and shown in many different occupations and life styles.

After the Austro-Hungarian Compromise of 1867, however, Franz Joseph I (1830-1916), Emperor of Austria (1848-1916) and Apostolic King of Hungary (1867-1916), presided over a tide of change during the half a century of his 'Dual' Monarchy. Innovative spirits flourished in many walks of life; big industrial firms sprang up and in their search for competitive edge founded product-oriented experimental laboratories in fields as diverse as telephony, lighting, pharmaceuticals, armaments, and electric locomotion, to name just a few. Later generations were to look back on these as the "good old days" of peace and prosperity.

The economic advance that occurred under the Austro-Hungarian Monarchy, however, did spur further development of the Hungarian language to furnish it with an adequate technical vocabulary to serve as a continued vehicle for professional communication and understanding —again reflecting the willingness of the culture to adapt itself to the modern world. This was particularly notable at the universities, where Hungarian gradually displaced German as the main language of tuition. Latin ceased to be an official administrative language already after 1844.

Fin-de-Siècle Budapest

After the unification of Buda, Pest, and Old-Buda into one municipality in 1873, the newly constituted Monarchy had two capital cities: Vienna and Budapest. While Vienna was the old imperial capital city of the Habsburgs, Budapest emerged astonishingly quickly, by the end of the 19th century, as a major, modern metropolitan center to serve as the administrative and economic capital of the Hungarian part of the Monarchy. In some ways it was designed to impress the many different ethnic minorities of the country by the visible ability of the *Magyar* ruling élite to govern their land. Overlooking the Danube across the Royal Palace, the building of Parliament dominated the landscape as a symbol of constitutionalism and political power.

Soon after the creation of the Austro-Hungarian Monarchy (1867) and the unification of Buda, Pest, and Óbuda into the representative and impressive Hungarian capital city of Budapest, a new, complex and modern, Hungarian intellectual elite emerged. Centered in the city of Budapest, this modernizing group came partly from the decaying landed gentry of feudal origins and partly from intellectually aspiring members of the assimilating (predominantly German and Jewish) middle-class. While creating metropolitan Budapest in the intellectual sense, they constituted themselves as a group through what proved to be a completely new and unique social and psychological experience.

Before the unification of Buda, Pest, and Óbuda, the population of Pest-Buda was 269,293 (1869). Between 1890 and 1910, the population grew from 492,227 to 880,371, with additional growth in the suburbs (from 61,289 to 217,360).[2] By 1930, the city had 1 million people, and by 1941, it reached 1,2 million. In the meantime, the suburbs grew from 311,000 in 1920 to 560,000 in 1940.[3]

Several economic and social factors contributed to the emergence of this gifted and creative professional group at the time of the rise and fall of the Austro-Hungarian Monarchy (1867-1918). In a country where the long decay of feudalism had become visible and the political and social system based on huge landed estates had come under sharp attack, the beginnings

2 Károly Vörös, ed., *Budapest története a márciusi forradalomtól az őszirózsás forradalomig* [The History of Budapest from the March Revolution to the Frost Flower Revolution] (Budapest: Akadémiai Kiadó, 1978), pp. 185, 577.

3 Miklós Horváth, ed., *Budapest története a forradalmak korától a felszabadulásig* [The History of Budapest from the Revolutions to the Liberation] (Budapest: Akadémiai Kiadó, 1980), p. 418.

of a new, capitalist society stimulated work in science, technology and the arts. The transformation of the Habsburg Monarchy and the creation of a "Hungarian Empire" contributed to an economic prosperity that brought about a building and transportation boom, the advancement of technology, and the appearance of a sophisticated financial system. The rise of a new urban middle-class affected the school system. Around 1900, there was a creative spirit in the air throughout Europe, permeating literature, music, the arts, and sciences. In Hungary, the poet Endre Ady, the editors of the new literary journal *Nyugat* [West] (1908), the composers Béla Bartók (1881-1945) and Zoltán Kodály (1882-1967), the artistic group The Eight, philosophers such as Georg Lukács (1885-1971) and Karl Mannheim (1893-1947), art historians such as Charles de Tolnay (1899-1981), Arnold Hauser (1892-1978), Lajos Fülep (1885-1970), and Frederick Antal (1887-1954), offered a new and stimulating agenda for artistic and social discourse. This creative atmosphere set the tone for a generation that included the many celebrated scientists born in the early years of the new century.

From assimilated Jewish-Hungarian upper middle-class families, prospective scientists such as Theodore von Kármán, John von Neumann, Leo Szilard (1898-1964), Eugene Wigner, and Edward Teller were born into this challenging intellectual atmosphere of Budapest, which bred provocative questions and pioneering answers. Paradoxically, the approaching decline of the Austro-Hungarian Monarchy seemed to have generated unusual sensitivity and creativity.[4] In many ways, the political and social decline of the monarchy created a special opportunity for Hungarian Jewry, which had grown and flourished throughout the fifty years of the Monarchy. The result was a professionally defined middle-class in Hungary, instead of a feudally-defined one. Whereas the first generations of assimilating middle-class Hungarian Jews concentrated on amassing material wealth, subsequent generations were destined to focus their activities on accumulating knowledge.[5] Their often-strong financial background enabled them to concentrate exclusively on their studies and eventually join the various scholarly or scientific groupings such as the *Társadalomtudományi Társaság* [Society for the Social Sciences], the *Galilei Kör* [Galileo Circle], or the journal *Huszadik Század* [Twentieth Century] where the critical social issues were often debated with a highly politicized focus. These circumstances provided a good schooling for this generation of prospective émigré intellectuals.

The period that ended with World War I saw a relatively peaceful cooperation and often-true friendship between Jew and Gentile in Hungary. What historian Raphael Patai described as "the love affair […] between the Jews and Hungary"[6] often resulted in intermarriages and oth-

4 László Mátrai, *Alapját vesztett felépítmény* [Superstructure Without Base] (Budapest: Magvető, 1976); Kristóf Nyíri, *A Monarchia szellemi életéről* [The Intellectual Life of the (Austro-Hungarian) Monarchy] (Budapest: Gondolat, 1980); J. C. Nyíri, *Am Rande Europas. Studien zur österreichisch-ungarischen Philosophiegeschichte* (Wien: Böhlau, 1988); Péter Hanák, *The Garden and the Workshop. Essays on the Cultural History of Vienna and Budapest.* Princeton, NJ: Princeton University Press, 1998); Károly Vörös, ed., *Budapest története* [The History of Budapest], Vol. IV (Budapest: Akadémiai Kiadó, 1978), pp. 321-723; John Lukacs, *Budapest 1900. A Historical Portrait of a City and Its Culture* (New York: Weidenfeld & Nicolson, 1988); Mary Gluck, *Georg Lukács and his Generation 1900-1918* (Cambridge, Mass. and London: Harvard UP, 1985); István Hargittai, *The Martians of Science: Five Physicists Who Changed the Twentieth Century* (New York: Oxford University Press, 2006), pp. 3-31.

5 William O. McCagg, Jr., *Jewish Nobles and Geniuses in Moderm Hungary* (Boulder, CO: East European Monographs, 1972, repr. 1986).

6 Raphael Patai, *The Vanished Worlds of Jewry* (New York: Macmillan, 1980), p. 68; cp. the recent contribution by Nobuaki Terao, "Oscar Jászi and the Magyar-Jewish Alliance" (offprint, 1997).

er forms of close social ties and networking. For those opposing the influx of Jews into Hungary, however, Budapest seemed a special, "un-Hungarian" case, out of line with Hungarian tradition. The popular conservative author Ferenc Herczeg expressed this sentiment in a straightforward manner when he spoke about "foreign elements in [the] chemistry" of Budapest.[7]

Assimilation was the by-word of the period: religious conversion, the dropping of German, Slavic, and particularly Jewish family names, and ennoblement were all standard practice.[8] The tortuous process of Jewish assimilation in Budapest was (often ironically) documented by the Hungarian novels of the period.[9] Nevertheless, the full social history of Magyarization at all levels is yet to be fully researched and written. The capital city of Hungary played the role of a Hungarian melting pot through the four decades preceding World War I. It attracted a vast number of migrant workers, professionals, and intellectuals from all quarters of the kingdom of Hungary and beyond. It became an energized meeting ground for a multitude of ethnic and religious groups with varying social norms, modes of behavior and mental patterns. The mixing and clashing, fusion and friction, of such diverse values and codes of behavior created an unparalleled outburst of creativity, a veritable explosion of productive energies. In this exciting and excited ambiance, a spirit of intellectual competitiveness was born, which favored originality, novelty and experimentalism. Budapest expected and produced excellence and became deeply interested in the secret of genius. For many of those who were later to be known both nationally and internationally as geniuses, Budapest seems to have been the natural place to have been born.

Hungary and the German Cultural Tradition

The German influence during this era also reached more widely, with Hungary in many ways constituting itself an outpost of German culture, whose icons–from authors Goethe and Schiller or philosophers Kant and Schopenhauer, through composers Beethoven, Brahms and Wagner, or painters Kaulbach and Piloty, to scientists Gauss, Haeckel and Brehm—were held in unparalleled esteem. Even news of the wider world outside the German universe usually reached Hungarian aristocratic libraries or the coffeehouses and salons of Budapest's middle-classes refracted through the medium of the German language and, inevitably, cultural paradigms.

The influence of German culture and Germany as a civilization was so strong in Hungarian history that we must address it in a variety of contexts. Their early learning experiences in

7 Zoltán Horváth, *Magyar századforduló. A második reformnemzedék története 1896-1914* [Hungarian fin-de-siècle. A history of the second reform generation]. (Budapest: 1961, 2nd ed. Budapest: Gondolat, 1974), pp. 205-6; quoted by John Lukács, *op. cit.,* p. 202.

8 Cf. József Gerő, ed., *A királyi könyvek. Az I. Ferenc József és IV. Károly által 1867-töl 1918-ig adományozott nemességek, főnemességek, előnevek és címerek jegyzéke* [Royal Books. A List of Persons Who Received Noble and Aristocratic Ranks, Titles, and Coats of Arms by Kings Ferenc József I and Károly IV between 1867 and 1918] (Budapest, 1940).

9 *Az éhes város* (The Hungry City, 1900) and *Az aruvimi erdő titka* (The Secret of the Aruvim Forest, 1917) by Ferenc Molnár, *Budapest* (1901) by Tamás Kóbor, *A nap lovagja* (The Knight of the Day, 1902) by Sándor Bródy, and *Andor és András* (Andrian and Andrew, 1903) by Ferenc Herczeg. Cf. Marianna Birnbaum, "Budapest in the Literature of the Fin-de-Siècle," in György Ránki and Attila Pók, eds., *Hungary and European Civilization,* Indiana Studies on Hungary, 3 (Budapest: Akadémiai Kiadó, 1989), pp. 331-342.

Germany also made a huge impact on many Hungarian scientists such as Loránd Eötvös (1848-1919), Leo Szilard, Edward Teller, and Lipót Fejér through their entire life. Both as a language and as a culture, German was a natural for upper- and middle-class Hungarians up to World War II. The *lingua franca* of the Habsburg Empire and of the Austro-Hungarian Monarchy, German was used at home, taught at school, spoken on the street, needed in the army.[10] This was more than a century-old tradition: the links between Hungary and both the Austrian and the German culture went back to the 18th century. For a considerable time in the 18th and 19th centuries, Hungary (or large parts of it) in many ways used to be on the fringes of the greater realm of German culture. We should emphasize again that the average middle-class "Hungarian" was typically German ("Schwab") or Jewish by origin and for him it was German culture and civilization that connected Hungary and the Austro-Hungarian Monarchy with Europe and the rest of the World. Middle-class sitting rooms in Austria, Hungary, Bohemia, Galicia, and Croatia typically boasted of the complete works of Goethe and Schiller, the poetry of Heine and Lenau, the plays of Grillparzer and Schnitzler.[11]

Not only was German literature and German translations read throughout the Empire: German was the language of the entire culture. When Baron József Eötvös (1813-1871), the great liberal statesman, man of letters and Hungarian Minister of Religion and Education, visited his daughter in a castle in eastern Hungary, he noted: “What contrasts! I cross Szeged and Makó, then visit my daughter to find Kaulbach on the wall, Goethe on the bookshelf and Beethoven on the piano”[12]

Throughout the entire Austro-Hungarian Monarchy and beyond, Hungarians looked to Germany to import modern theories and establish modern practices. The study of the German school system had a great tradition throughout the 19th century. For generations of Hungarian lawmakers, the German school provided the finest example in Europe. Two widely spaced examples are characteristic. When young Bertalan Szemere (1812-1869), a future Prime Minister of Hungary, went in 1836 to Berlin to study “what was best in each country, [he] tried to consider schools in Germany, the public life in France, and prisons in Britain

[. . .]”[13] A generation later, the ideas and know-how of modern teacher training were studied in, and imported from, Germany by Mór Kármán in the early 1870s.

As late as December 1918 Cecilia Polányi (1852-1939), the mother of Michael (1891-1976) and Karl Polanyi (1886-1964) and grandmother of Nobel laureate John C. Polanyi (b. 1929), intended to study the curricula and methods of German institutions in the field of "practical social work" and for this planned visits to Berlin, Frankfurt am Main, Mannheim, Hannover, Düsseldorf, Cologne, Augsburg, Munich, Heidelberg, Königsberg, and a host of other places where the various *Soziale Frauenschulen, Frauenakademie, Frauenseminare* were the very best in Europe.[14]

10 István Deák, *Beyond Nationalism: A Social and Political History of the Habsburg Officer Corps, 1848-1918* (New York-Oxford: Oxford University Press, 1990), pp. 83, 89, 99-102.

11 Cf. Gyula Illyés, *Magyarok. Naplójegyzetek,* 3rd ed. (Budapest: Nyugat, n.d. [1938]), Vol. II, p. 239.

12 István Sőtér, *Eötvös József* [József Eötvös] 2nd rev. ed. (Budapest: Akadémiai Kiadó, 1967), p. 314.

13 Journal entry from Berlin, October 31, 1836. Cf. Bertalan Szemere, *Utazás külföldön* [Traveling Abroad] (Budapest: Helikon, 1983), p. 59.

14 Cecilia Polányi to the Minister of Religion and Public Education, Budapest, December 11, 1918 and enclosures. (Hungarian and German) Michael Polanyi Papers, Box 20, Folder 1, Department of Special Collec-

Efforts to study and imitate what was German were also natural because German was then the international language of science and literature: in the first eighteen years of the Nobel Prize, between 1901 and 1918, there were seven German Nobel laureates in chemistry, six in physics, four (and one Austro-Hungarian) in medicine, and four in literature.[15] Scholars and scientists read the *Beiträge,* the *Mitteilungen*, or the *Jahrbücher* of their special field of research or practice, published in some respectable German university town such as Giessen, Jena, or Greifswald. The grand tour of a young intellectual, artist, or professional would unmistakably lead the prospective scholar to Göttingen, Heidelberg, and increasingly Berlin. Artists typically went to Munich to study with Munich art professor Karl von Piloty (1826-1886).[16]

The Hungarian middle-classes often read local papers published in German, which were available everywhere in the monarchy until its dissolution and even beyond. Founded in 1854, the authoritative *Pester Lloyd* of Budapest, for example, continued as one of the most appreciated and well-read papers of the Budapest middle-class until almost the end of World War II. German in language but committed to Hungarian culture,[17] this part of the press helped bridge the gap between the two cultures. In much of the 18th and 19th centuries, German novels and poetry written and published in Hungary were just as integral a part of the Greater German *[Gesamtdeutsch]* literature as anything written in Königsberg or Prague.[18] The Jewish population of the Empire/Monarchy, particularly its educated urban middle-class, embraced German primarily as a new, common language and contributed to making the Austrian realm a part and not just an outskirt of German civilization.[19] For socially aspiring Jewish families, German was the language of education and upward mobility.

With all this infusion of German blood into Hungarian musical life and education, Budapest in the early 1900s still was not comparable to Berlin. Young and gifted pianist and composer Ernő Dohnányi (1877-1960) considered the *Hochschule für Musik* in Berlin a much greater challenge. "To choose Budapest instead of Berlin would have been such a sacrifice on my part which, considering my youth, the fatherland cannot demand and, considering my art, I cannot make," he wrote to the director of the Budapest Music Academy around 1905. "Berlin is unquestionably the center of the musical world today. Budapest, we must admit, does not play even a small role in the world of music. Even if it is true that the *Hochschule* of Berlin is simply the center of a clique, that clique is enormous and has played a role for decades whereas the musical world doesn't even notice whether or not I take a dominant position in Bud-

tions, University of Chicago Library, Chicago, Ill.

15 *The World Almanac and Book of Facts 2009* (Pleasantville, NY: World Almanac Books, 2009), pp. 295-298.

16 Károly Lyka, *Magyar művészélet Münchenben* [Hungarian Artist-Life in Munich] (2nd ed., Budapest: Corvina, 1982); László Balogh, *Die ungarische Facette der Münchner Schule* (Mainburg: Pinsker-Verlag, 1988).

17 József Kiss, "Petőfi in der deutschsprachigen Presse Ungarns vor der Märzrevolution," in *Studien zur Geschichte der deutsch-ungarischen literarischen Beziehungen* (Berlin, 1969), pp. 275-297.

18 László Tarnói, *Parallelen, Kontakte und Kontraste. Die deutsche Lyrik um 1800 und ihre Beziehungen zur ungarischen Dichtung in den ersten Jahrzehten des 19. Jahrhunderts* (Budapest: ELTE Germanisztikai Intézet, 1998), pp. 203-322; Ulrik R. Monsberger, *A hazai német naptárirodalom története 18 21-ig* [A History of German Calendar Literature in Hungary to 1821] (Budapest, 1931).

19 György Szalai, "A hazai zsidóság magyarosodása 1849-ig," [The Magyarization of the Hungarian Jewry to 1849], *Világosság* 15 (1974), pp. 216-223; Róza Osztern, *Zsidó újságírók és szépírók a magyarországi német nyelvű időszaki sajtóban, a 'Pester Lloyd' megalapításáig, 1854-ig* [Jewish Journalists and Authors in the German Periodical Press of Hungary, up to the Foundation of the Pester Lloyd in 1854] (Budapest, 1930).

apest."[20] Dohnányi stayed in Berlin until World War I and, as *Ernst von* Dohnányi, became one of the internationally most distinguished professors of the *Hochschule für Musik*. Berlin in the early pre-World War I era proved to be an irresistible magnet for the new Hungarian intellectual and professional classes. Many of the young Hungarians who frequented Berlin around the turn of the century were Jewish. The Jewish-Hungarian middle-class felt at home in imperial Germany and sent their sons and daughters there to study. After completing their courses in Budapest before World War I, Hungary's up-and-coming mathematicians saw Göttingen and Berlin as the most important places to study. As a very young man, the celebrated mathematician Lipót Fejér spent the academic year 1899-1900 in Berlin where he attended the famous seminar of Hermann Amandus Schwarz (1843-1921). In 1902-03 he studied in Göttingen and in subsequent years returned to both universities.[21] A gifted student of Fejér, Gábor Szegő (1895-1985), also followed his path and went to study in prewar Berlin, Göttingen, and Vienna, and later became professor of mathematics at Stanford.[22]

II The Legacy of Teaching

Baron Loránd Eötvös

The key personality in late 19th century Hungarian science and mathematics was Baron Loránd Eötvös. Son of the author, philosopher, and statesman Baron József Eötvös, young Loránd was not only a major physicist in his own right, but also one of the truly great organizers of Hungarian science. He was three times (1911, 1914, 1917) nominated for the Nobel Prize.[23] As a young man, Loránd Eötvös was greatly influenced by the ideas and personality of his father, a leading Liberal before and during the 1848 revolution, a dedicated critic of the Hungarian nobility and the political system upheld by it. Still surviving in Budapest, his rich personal library shows him as a man of immense erudition and sophisticated culture, with an avid interest in world history.[24] As Arthur J. Patterson (1835-1899), a contemporary British observer put it, Baron József Eötvös was a witness who cannot be accused of partiality to this class since "his novel, *The Village Notary*, was written to satirize the very institutions to which they were especially attached".[25]

Loránd Eötvös studied chemistry, physics, and mathematics at the [Ruprecht-Karls] University of Heidelberg in 1867-70 with the chemist Robert Wilhelm Bunsen (1811-1899) as well as the physicists Hermann Ludwig Ferdinand von Helmholtz (1821-1894) and Gustav Robert

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20 Bálint Vázsonyi, *Dohnányi Ernő* (Budapest: Zeneműkiadó, 1971), pp. 67-68.

21 Gábor Szegő, "Leopold Fejér: In Memoriam, 1880-1959," *Bulletin of the American Mathematical Society,* Vol. 66, No. 5 (September 1960), pp. 346-347.

22 [Gábor Szegő] "Lebenslauf." Gábor Szegő Papers, SC 323, Boxes 85-036. Department of Special Collections and University Archives, Stanford University Libraries, Stanford, CA.

23 Mihály Beck, „A Nobel-díj és a magyar Nobel-díjasok" [The Nobel Prize and the the Hungarian Nobel Laureates], http://www.kfki.hu/chemonet/hun/teazo/nobel/nobeldij.html (downloaded May 6, 2009); cf. Mihály Beck, „A Díj és a magyarok," Természet Világa 126 (1995), pp. 531-535.

24 Gábor Gángó, Hrsg., *Die Bibliothek von Joseph Eötvös* (Budapest: Argumentum, 1995)

25 Arthur J. Patterson, *The Magyars: Their Country and Institutions* (London: Smith, Elder & Co., 1869), Vol. I, p. 271. Cf. Tibor Frank, „Arthur J. Patterson and the Austro-Hungarian Settlement of 1867," in: László Péter, Martin Rady (eds.), *British-Hungarian Relations Since 1848* (London: Hungarian Cultural Centre─School of Slavonic and East European Studies, University College, 2004), pp. 47-62.

Kirchhoff (1824-1887).[26] These were the heydays of natural sciences in Heidelberg, a centre for Liberal thought and openmindedness. Eötvös, Sr. maintained regular contact with his son Loránd. The correspondence between father and son reflected their strong devotion to 19th century ideals such as rationalism, progress, enlightened thinking, and the openness of mind. A touch of social responsibility permeates the letters which were partly published.[27]

Loránd benefited of the intellectual and political legacy of his father as well as that of his uncle, Ágoston Trefort (1817-1888) who for 16 years continued József Eötvös's great Liberal work as Hungarian Minister of Religion and Education (1872-88) as well as President of the Hungarian Academy of Sciences (1885-88).[28] It is important to notice that, though for a very limited time, that Loránd Eötvös himself became Minister of Religion and Education (1894-95), in addition to his long and distinguished service as President of the Hungarian Academy of Sciences (1889-1905). It is no exaggeration to claim that the Eötvös-Trefort family dominated Hungarian science and education policies between 1866 and 1905.

As a scientist, Loránd Eötvös is best remembered today for the Eötvös Law in surface tension and for his gravitational torsion balance measurements which opened up pioneering ways to identify new sources of energy and particularly of natural gas.[29] His educational achievements, are, however, just as important.

With his German (Heidelberg, Königsberg) educational background and inspiration, Eötvös created a small, private Mathematics Circle in Budapest, in the fall of 1885, to build an informal network among university professors and high school teachers and their best students.[30] As of 1891, this circle continued as the *Mathematikai és Physikai Társulat* [Society of Mathematics and Physics] with some 300 members (including three women). Loránd Eötvös served as the first president of the *Társulat*, which launched *Mathematikai és Physikai Lapok* [Mathematical and Physical Papers]. In his inaugural address, Eötvös expressed his hope that "we will do great service to the general cultural development of the country, because

26 Promotionsakten von Roland von Eötvös, Ruprechts-Karl-Universität, Universitätsarchiv, Heidelberg, UAH H-IV-102/72; copies in the custody of the University Archive, Eötvös Loránd University, Budapest. Cf. István Rosta, *Eötvös Loránd* (Budapest: Elektra, 2008), p. 11.

27 Mihály Benedek, ed., *Eötvös József levelei fiához, Eötvös Lorándhoz* [The letters of József Eötvös to his son, Loránd Eötvös](Budapest: Szépirodalmi Könyvkiadó, 1988). I have also studied Loránd's letters originally in the custody of Patrona Hungariae Gyakorló Általános Iskola, Gimnázium, Diákotthon, Zene- és Szakiskola, Budapest, copies of which are today in the Archive of Eötvös Loránd University, Budapest. I am grateful to Dr. László Szögi, Director of the University Library and Archive of Eötvös Loránd University for kindly providing access to the Eötvös-documents in the custody of the Archive.

28 Miklós Mann, *Trefort Ágoston élete és működése* [The life and work of Ágoston Trefort] (Budapest: Akadémiai Kiadó, 1982)

29 Loránd Eötvös, "Bericht über Arbeiten mit der Drehwage ausgeführt im Auftrage der kön. ung. Regierung in den Jahren 1909-1911," Verhandlungen der XVII. allgemeinen Konferenz der internationalen Erdmessung in Hamburg, 1912, Vol. I, pp. 427-438. Cf. Gy. Tóth, L. Völgyesi, „Importance of Eötvös Torsion Balance Measurements and Their Geodetic Applications," *Geophysical Research Abstracts*, Vol. 5, 13217, 2003. For the collected works of Eötvös see Loránd Eötvös, *Gesammelte Arbeiten*. Hrsg. P[ál] Selényi (Budapest: Akadémiai Kiadó, 1953), LXXX, 384 p. On the ever growing Eötvös-literature see Sándor Mikola and János Renner, eds., „Irodalom" [Bibliography], in: Izidor Fröhlich, ed., *Báró Eötvös Loránd Emlékkönyv* [Baron Loránd Eötvös Memorial Volume] (Budapest: Magyar Tudományos Akadémia, 1930), pp. 287-317; Elek Környei, ed., *Eötvös Loránd. A tudós és művelődéspolitikus írásaiból* [Loránd Eötvös. From the Writings of the scientist and the cultural politician] (Budapest: Gondolat Kiadó, 1964), pp. 379-421.

30 Eötvös also surrounded himself with a circle of fellow Hungarian physicists in Heidelberg, see Gyula Radnai, „Az Eötvös-korszak" [The Eötvös-era], *Fizikai Szemle*, Vol. XLI, No. 10, 1991, p. 349.

undoubtedly, the success of teaching in both higher and secondary schools depends above all on the scientific preparation of the teachers."[31] The special emphasis on the training of mathematics and physics teachers and on the achievement of the secondary school student in Hungary can thus be traced back to Loránd Eötvös. Hungarian-born mathematics professor Peter Lax (b. 1926) of the Courant Institute of Mathematical Sciences at New York University remembered Eötvös as a professor of his parents who were joined by a host of students in "the lecture room just to be able to hear him lecture."[32]

In his 1891 inaugural address as the newly installed Rector of Budapest [today: Eötvös Loránd] University Loránd Eötvös emphatically argued for independent research and independent thinking: "I do not call a scientist someone who knows a lot, but someone who does research in science. […] Independence in thinking can only be fostered by a teacher who thinks independently himself, and it is this very independence that is most necessary for the scientist as a man of practice."[33]

As students were expected to be challenged in regular national interschool competitions in mathematics and science, the *Mathematikai és Physikai Társulat* honored Eötvös by launching an annual mathematics and physics contest "in order to discover those who are exceptional in these fields."[34] Appropriately named the Eötvös Competition, a first and a second prize (the Eötvös Prize) were awarded to the best secondary school graduates. As only secondary school material was included in the test, no additional study was necessary for the exam. Results were reported directly to the Ministry of Education, along with the names of the teachers of the winners, and were published in the *Mathematikai és Physikai Lapok.*

To support preparations for future contentions, the same year, 1894, also saw the inauguration of *Középiskolai Mathematikai Lapok* [High School Papers in Mathematics], edited by Dániel Arany (1863-1945), an outstanding high school mathematics teacher from the West Hungarian city of Győr. László Rátz (1863-1930), the future teacher of mathematics of John von Neumann and Eugene Wigner, continued Arany's editorial work, between 1896 and 1914. The problems to be solved included a wide variety of fields such as algebra, calculus, combinatorics, geometry, number theory, and trigonometry, and the problems always required creative thinking. Pride, rather than money was the reward of the best students.

The organizational structure of these competitions, along with the related new publications, provided a well-structured and carefully regulated framework of preparation for future professional challenges these students would face.

The idea of founding awards and contests was not restricted to the Eötvös Prize alone. For example, it was at the personal instigation of Loránd Eötvös that Andor Semsey (1833-1923), a rich patron of the Hungarian National Museum, established fellowships and prizes in vari-

31 Loránd Eötvös, „Szaktársainkhoz" [To our colleagues], *Mathematikai és Physikai Lapok,* Vol. 1, 1892, p. 1. Quoted by Ágnes Árvai Wischenberg, *op. cit.*, p. 23.

32 Interview with Peter Lax, May 3, 1983, quoted by Ágnes Árvai Wischenberg, *op. cit.,* p. 56.

33 Loránd Eötvös, Inaugural speech as Rector at the University of Budapest, September 15, 1891. Published by Elek Környei, ed., *Eötvös Loránd, op. cit*., pp. 201-202.

34 Értesítő a Mathematikai és Physikai Társulat választmányának f. é. Június hó 22-ikén tartott üléséről" [Minutes of the June 22 meeting of the Mathematical and Physical Society], *Mathematikai és Physikai Lapok* 3, 1894, 197-198, quoted by Ágnes Árvai Wischenberg, *op. cit.,* p. 26.

ous scholarly and scientific fields to inspire talented young people to do research.[35] Also, upon the death of the reputable high school mathematics teacher Adolf Prilisauer (1859-1913), his provincial city of Kaposvár in Western Hungary along with his former teaching colleagues, established a prize for the best student (or, later, students) in mathematics.[36]

The *Középiskolai Matematikai és Fizikai Lapok* [Highschool Papers in Mathematics and Physics], the *Eötvös Loránd fizikai verseny* [Eötvös Loránd Competition in Physics] and the *Arany Dániel országos matematika verseny* [Arany Dániel National Competition in Mathematics] have survived until today and maintain the living tradition of an excellent mathematics education based on early training, competitive spirit, and the recognition of talent.[37]

III The Tradition Exported

In a pioneering inquiry into the nature of problems and the solution of a problem, Michael Polanyi defined one of the most crucial questions of his generation. European mathematicians and scientists were particularly welcome in the United States from the 1920s onwards. “To recognize a problem which can be solved and is worth solving is in fact a discovery in its own right,” Polanyi declared the creed of his generation in his 1957 article for *The British Journal for the Philosophy of Science.*[38] Polanyi spoke for, and spoke of, his generation when discussing originality and invention, discovery and heuristic act, investigation and problem solving.

George Pólya, Mathematician

Hungarian-born mathematician George Pólya was one of those who channeled the Hungarian and, more broadly speaking, Central European school tradition into American education in a series of books and articles, starting with his 1945 book *How to Solve It.*[39] Among other ideas, Pólya transplanted the Eötvös Competition to post-World War II Stanford University which makes it important to discuss his career at this point. In 1944, Pólya remembered the time when, at the turn of the century in Hungary,

> he was a student himself, a somewhat ambitious student, eager to understand a little mathematics and physics. He listened to lectures, read books, tried to take in the solutions and facts presented, but there was a question that disturbed him again and again: “Yes, the solution seems to work, it appears to be correct; but how is it possible to invent such a solution? Yes, this experiment seems to work,

35 Izidor Fröhlich, “Báró Eötvös Loránd emlékezete” [The Memory of Baron Loránd Eötvös], in: Izidor Fröhlich, ed., *Báró Eötvös Loránd Emlékkönyv*, *op. cit.,* pp. 47-48.

36 Gyula Kovács-Sebestény and Károly Pongrácz, „Felhívás” [Appeal], Kaposvár, June 1913. *A kaposvári Magyar Királyi Állami Főgimnázium Emlékkönyve 1812-1912* [Centenary Memorial of the Hungarian Royal State High School at Kaposvár] (Kaposvár: Szabó Lipót Könyvsajtója, 1913), pp. 177-178.

37 János Gordon Győri, Mária Halmos, Katalin Munkácsy, Józsefné Pálfalvi, eds., *A matematikatanítás mestersége. Metertanárok a matematikatanításról* [The Arts and Crafts of Mathematics Education. Master Teachers on Teaching Mathematics] (Budapest: Gondolat Kiadó, 2007).

38 Michael Polanyi, “Problem Solving,” *The British Journal for the Philosophy of Science,* Vol. VIII, No. 30, August 1957, pp. 89-103; quote p. 89.

39 G. Pólya, *How to Solve it. A New Aspect of Mathematical Method* (Princeton, N.J.: Princeton University Press, 1945). *How to Solve It* has never been out of print and has sold well over 1 million copies. It has been translated into 17 languages, probably a record for a modern mathematics book. Gerald L. Alexanderson, “Obituary. George Pólya,” *Bulletin of the London Mathematical Society,* Vol. 19, 1987, p. 563, 603.

> this appears to be a fact; but how can people discover such facts? And how could I invent or discover such things by myself?"[40]

Pólya came from a distinguished Jewish-Hungarian family of academics and professionals. His father, Jakab, an eminent lawyer and economist, provided the best education for his children. They included George's brother, Jenő Pólya, the internationally recognized Hungarian professor of surgery and honorary member of the American College of Surgeons.[41] George Pólya first studied law, later changing to languages and literature, then philosophy and physics, to settle finally on mathematics, in which he received his Ph.D. in 1912. Just like most prospective scientists, medical doctors and mathematicians, he was a student of Loránd Eötvös in physics. He also studied with the mathematician Lipót Fejér (mathematics), whom he considered one of the people who influenced Hungarian mathematics in a definitive way.[42]

For emancipated Jews in Hungary who received full rights as citizens in 1867, it was the Hungarian Law 1867:XII that made it possible, among other things, to become teachers in high schools and even professors at universities. This is one of the reasons that lead to the explosion of mathematical talent in Hungary, just as it happened in Prussia after the emancipation of Jews in 1812.[43] John Horvath of the University of Maryland was one who pointed out that the overwhelming majority of mathematicians in Hungary were Jewish in the early 20th century. Pursuing scientific professions, particularly mathematics, secured a much desired social position for (in most cases) sons of Jewish-Hungarian families, who longed not only for emancipation, but for full equality in terms of social status and psychological comfort. Thus, in many middle-class Jewish families, at least one of the sons was directed into pursuing a career in academe.

Culture in the second half of the 19th century became a matter of high prestige in Hungary, where the tradition of respect for scientific work started to loom large after the *Ausgleich,* the Austro-Hungarian Compromise in 1867 between Austria and Hungary. For sons of aspiring Jewish families, a professorship at a Budapest university or membership in the Hungarian Academy of Sciences promised entry into the Hungarian élite and eventual social acceptance in Hungarian high society, an acknowledged way to respectability. Distinguished scientists such as Manó Beke (1862-1946), Lipót Fejér, Mihály Fekete (1886-1957), Alfréd Haar (1885-1933), Gyula (1849-1913) and Dénes Kőnig (1884-1944), Gusztáv Rados (1862-1942), Mór Réthy (1848-1925), Frigyes Riesz (1880-1956), and Lajos Schlesinger (1864-1933) belonged to a remarkable group of Jewish-Hungarian mathematical talents, who, after studying at major German universities, typically Göttingen or Heidelberg, became professors in Hungary's few

40 G. Pólya, "*How to Solve It*," *op. cit.,* p. vi.

41 Vilmos Milkó, "Pólya Jenő emlékezete [In memoriam Jenő Pólya]," *Archivum Chirurgicum*, Vol. 1, No. 1, 1948, p.1.

42 G. Pólya, "Leopold Fejér," *Journal of the London Mathematical Society,* Vol. 36., 1961, p. 501.

43 R. Hersch and V. John-Steiner, "A Visit to Hungarian Mathematics," Ms., pp. 35-37. I received a copy of this article from Professor Gerald L. Alexanderson of the Department of Mathematics, Santa Clara University, Santa Clara, CA. John Horváth compared this explosion of Jewish talent after the Jewish emancipation to the surprising number of sons of Protestant ministers entering the mathematical profession in Hungary after World War II, "Those kids would have become Protestant ministers, just as the old ones would have become rabbis [...] mathematics is the kind of occupation where you sit at your desk and read. Instead of reading the Talmud, you read proofs and conjectures. It's really a very similar occupation." R. Hersch and V. John-Steiner, *op. cit.,* p.37.

universities before World War I. Some of them, like Gyula Kőnig and Gusztáv Rados, even became university presidents at the Technical University of Budapest. There were several other renowned scientists active in related fields, such as physicist Ferenc Wittmann (1860-1932), engineer Donát Bánki (1859-1922), and some others. Mathematicians were also needed outside the academic world: just before the outbreak of World War I, George Pólya was about to join one of Hungary's large banks, at the age of 26, with a Ph.D. in mathematics and a working knowledge of four foreign languages in which he already published important articles.[44]

Despite what we know about the social conditions which nurtured and even forced out the talent of these many extraordinary scientists, how this occurred still remains somewhat mysterious. Stanisław Ulam (1909-1984) recorded an interesting conversation with John von Neumann when describing their 1938 journey to Hungary in his *Adventures of a Mathematician*.

> I returned to Poland by train from Lillafüred, traveling through the Carpathian foothills [. . .] This whole region on both sides of the Carpathian Mountains, which was part of Hungary, Czechoslovakia, and Poland, was the home of many Jews. Johnny [von Neumann] used to say that all the famous Jewish scientists, artists, and writers who emigrated from Hungary around the time of the first World War came, either directly or indirectly, from these little Carpathian communities, moving up to Budapest as their material conditions improved. The [Nobel Laureate] physicist I[sidor] I[saac] Rabi[45] was born in that region and brought to America as an infant. Johnny used to say that it was a coincidence of some cultural factors which he could not make precise: an external pressure on the whole society of this part of Central Europe, a feeling of extreme insecurity in the individuals, and the necessity to produce the unusual or else face extinction.[46]

An interesting fact about the turn of the century Jewish-Hungarian mathematicians was that several of them could multiply huge numbers in their head. This was true of von Kármán, von Neumann and Edward Teller. Von Neumann, in particular, commanded extraordinary mathematical abilities. Nevertheless, there is no means available to prove that this prodigious biological potential was more present in pre-World War I Hungary than elsewhere in Europe.[47]

44 György Pólya to Baron Gyula Madarassy-Beck, Paris, February 23, 1914. I am grateful to Professor Gerald Alexanderson of the University of Santa Clara for showing me this document as well as his collection of Pólya documents that were to be transferred to the George Pólya Papers, Department of Special Collections and University Archives, Stanford University Libraries, Stanford, CA.

45 I. I. Rabi (1898-1988), Nobel Prize in Physics, 1944.

46 S. M. Ulam*, Adventures of a Mathematician* (New York: Scribner's, 1976), p. 111. Cf. Tibor Fabian, "Carpathians Were a Cradle of Scientists," Princeton, NJ, November 16, 1989, *The New York Times,* December 2, 1989.—George Pólya's nephew John Béla Pólya had an even more surprising, though cautious proposition to make. He suggested that through George Pólya's mother, Anna Deutsch (1853-1939), Pólya was related to Eugene Wigner and Edward Teller, "who are thought to have" ancestry originating from the same region between the towns of Arad and Lugos in Transylvania (then Hungary, today Romania). Though this relationship is not yet documented and should be taken at this point merely as a piece of Pólya family legend, it is nonetheless an interesting reflexion of the strong belief in the productivity of the Jewish community in North-Eastern Hungary and Transsylvania in terms of mathematical talent. John Béla Pólya, "Notes on George Pólya's family," attached to John Béla Pólya to Gerald L. Alexanderson, Greensborough, Australia, July 28, 1986.—I am deeply grateful to Gerald L. Alexanderson of Santa Clara University, Santa Clara, CA, for his generous and highly informative support of my research on George Pólya in 1988 and after.

47 Norman Macrae, *John von Neumann* (New York: Pantheon, 1992), p. 9; J. M. Rosenberg, *Computer Prophets* (New York: Macmillan, 1969) p. 155. ff.; Edward Teller and Alan Brown, *The Legacy of Hiroshima* (Garden City: Doubleday, 1962) p. 160. Cf. William O. McCagg, Jr., *op. cit.,* 211.

Similarly, heuristic thinking was also a common tradition that many other Hungarian mathematicians and scientists shared. John von Neumann's brother remembered the mathematician's "heuristic insights" as a specific feature that evolved during his Hungarian childhood and appeared explicitly in the work of the mature scientist.[48] Von Neumann's famous high school director, physics professor Sándor Mikola (1871-1945), had made a special effort to introduce heuristic thinking into the elementary school curriculum in Hungary by the 1900s.[49]

Fejér drew a number of gifted students to his circle, such as Mihály Fekete, Ottó Szász (1884-1952), Gábor Szegő and, later, Paul Erdős. His students remembered Fejér's lectures and seminars as "the center of their formative circle, its ideal and focal point, its very soul." "There was hardly an intelligent, let alone a gifted, student who could exempt himself from the magic of his lectures. They could not resist imitating his stress patterns and gestures, such was his personal impact upon them."[50] George Pólya remembered Fejér's personal charm and personal drive to have been responsible for his great impact: "F[ejér] influenced more than any other single person the development of math[ematic]'s in Hungary. . ."[51]

Pólya, however, soon went to Vienna where he spent the academic year of 1910-11, after receiving his doctorate in mathematics in Budapest. In 1912-13, he went to Göttingen, and later to Paris and Zurich, where he took an appointment at the *Eidgenössische Technische Hochschule Zürich* [Swiss Federal Institute of Technology Zurich]. He became full professor at the ETH in 1928.

A distinguished mathematician, Pólya drew on several decades of teaching mathematics based on new approaches to problem solving, first as a professor in Zurich, Switzerland, and later at Stanford, California. It was in Zurich that Pólya and fellow Hungarian Gábor Szegő started their long collaboration by signing a contract in 1923 to publish their much-acclaimed joint collection of *Aufgaben und Lehrsätze aus der Analysis* [Problems and theorems in analysis].[52] Considered a mathematical masterpiece even today, *Aufgaben und Lehrsätze* took several years to complete, and it continues to impress mathematicians not only with the range and depth of the problems contained in it, but also with its organization: their grouping of problems, not by subject but by solution method, was a novelty.[53]

In the United States after 1940, and at Stanford as of 1942, Pólya became the highest authority on the teaching of problem solving in mathematics.

48 Nicholas A. Vonneuman, *John Von Neumann as Seen by His Brother* (Meadowbrook, PA, 1987), p. 44.

49 Sándor Mikola, "Die heuristischen Methode im Unterricht der Mathematik der unteren Stufe," in E. Beke und S. Mikola, Hg., *Abhandlungen über die Reform des mathematischen Unterrichts in Ungarn* (Leipzig und Berlin: Teubner, 1911), pp. 57-73.

50 Gábor Szegő, "[Lipót Fejér]," MS. Gábor Szegő Papers, SC 323, Department of Special Collections and University Archives, Stanford University Libraries, Stanford, CA.

51 [Lecture outline, n.d. unpublished MS] George Pólya Papers, SC 337, 87-034, Box 1.

52 Georg Pólya—Gábor Szegő, *Aufgaben und Lehrsätze aus der Analysis* (Berlin: Springer, 1925, new editions: 1945,1954, 1964, 1970-71), Vols. I-II; Translations: English, 1972-76; Bulgarian, 1973; Russian, 1978; Hungarian, 1980-81.

53 Gerald L. Alexanderson, "Obituary. George Pólya," *op. cit.,* p. 562.

With his arrival at the United States, Pólya started a new career based on his new-found interest in teaching and heuristics.[54] He developed several new courses such as his "Mathematical Methods in Science," which he first offered in the Autumn 1945 quarter at Stanford, introducing general and mathematical methods, deduction and induction, the relationship between mathematics and science, as well as the "use of physical intuition in the solution of mathematical problems."[55]

After his widely used textbook *How to Solve It*, Pólya published several more books on problem solving in mathematics such as the two-volume *Mathematics and Plausible Reasoning* (1954), and *Mathematical Discovery,* in 1965. Both became translated into many languages.[56] Towards the end of his career his "profound influence of mathematical education" was internationally recognized, as suggested by the words of Sir James Lighthill (1924-1998).[57]

Pólya's significance in general methodology seems to have been his proposition for interpreting heuristics as problem solving, more specifically, the search for those elements in a given problem that may help us find the right solution.[58] For Pólya, heuristics (*Erfindungskunst)* equaled an inventive or imaginative power, the ability to invent new stratagems of learning, and it bordered not only on mathematics and philosophy but also on psychology and logic. In this way, a centuries-old European tradition was renewed and transplanted into the United States where Pólya had tremendous influence on subsequent generations of mathematics teachers well into the 1970s. In 1971, the aged mathematician received an honorary degree at the University of Waterloo, where he addressed the Convocation, calling for the use of "heuristic proofs":

> In a class for future mathematicians you can do something more sophisticated: You may present first a heuristic proof, and after that a strict proof, the main idea of which was foreshadowed by the heuristic proof. You may so do something important for your students: You may teach them to do research.[59]

Pólya had lasting influence on a variety of thinkers in and beyond mathematics. The first curriculum recommendation of the [American] National Council of the Teachers of Mathematics

54 Gerald L. Alexanderson, "Obituary. George Pólya," *op. cit.*, p. 563; on "Pólya the mathematician and teacher," see pp. 566-570.

55 Paul Kirkpatrick, Acting Dean, School of Physical Sciences, Stanford University, Course outline, September 4, 1945, George Pólya Papers, SC 337, 87-137, Box 2.

56 G. Pólya *Mathematics and Plausible Reasoning* (Princeton, N.J.: Princeton University Press, 1954, 2nd ed. 1968), Vols. 1-2. Translations: Bulgarian, 1970; French, 1957-58; German, 1962-63; Japanese, 1959; Romanian, 1962; Russian, 1957, 1975; Spanish, 1966; Turkish, 1966. G. Pólya, *Mathematical Discovery. On Understanding, Learning, and Teaching Problem Solving* (New York-London-Sidney: John Wiley and Sons, 1965, Vols. 1-2; combined paperback ed. 1981), Translations: Bulgarian, 1968; French, 1967; German, 1966, 1967, 1979, 1983; Hungarian, 1969, 1979, Italian, 1970-71, 1979, 1982; Japanese, 1964; Polish, 1975; Romanian, 1971; Russian 1970, 1976. Cf. Gerald L. Alexanderson, "Obituary. George Pólya," *op. cit.,* pp. 604-605.

57 A good example was the Second International Congress on Mathematical Education at the University of Exeter, England. Cf. the invitation sent to Pólya by the Chairman of the Congress, Professor Sir James Lighthill, FRS, June 23, 1971. [Cambridge] George Pólya Papers, SC 337, 87-034, Box 1.

58 G. Pólya, "Die Heuristik. Versuch einer vernünftigen Zielsetzung," *Der Mathematikunterricht,* Heft 1/64 (Stuttgart: Ernst Klett, 1964); cf. "L'Heuristique est-elle un sujet d'étude raisonnable?", *La méthode dans les sciences modernes*, "Travail et Méthode", numéro hors série, pp. 279-285.

59 G. Pólya, "Guessing and Proving." Address delivered at the Convocation of the University of Waterloo, October 29, 1971. George Pólya Papers, SC 337, 87-034, Box 1.

suggested that "problem solving be the focus of school mathematics in the 1980s" [in the U.S.]. The 1980 NCTM Yearbook, published as *Problem Solving in School Mathematics,* the Mathematical Association of America's Compendia of Applied Problems and the new editor of the *American Mathematical Monthly,* Paul R. Halmos (1916-2006), all called for more use of problems in teaching.[60] Pólya was an integral part of the "problem solving movement" that cut a wide swath in the 1980s.[61] Philosopher Imre Lakatos (1922-1974), a fellow-Hungarian who described mathematical heuristics as his main field of interest in 1957, acknowledging his debt to Pólya's influence, and particularly to *How to Solve It,* which he translated into Hungarian.[62]

Critics, however, like mathematician Alan H. Schoenfeld, pointed out that while Pólya's influence extended "far beyond the mathematics education community," "the scientific status of Pólya's work on problem solving strategies has been more problematic."[63] Students and instructors often felt that the heuristics-based approach rarely improved the actual problem-solving performance itself. Researchers in artificial intelligence claimed that they were unable to write problem solving programs using Pólya's heuristics. "We suspect the strategies he describes epiphenomenal rather than real."[64] Recent work in cognitive science, however, has provided methods for making Pólya's strategies more accessible for problem solving instruction. New studies have provided clear evidence that students can significantly improve their problem-solving performance through heuristics.[65] As suggested by Alan H. Schoenfeld, "[i]t may be possible to program computer knowledge structures capable of supporting heuristic problem-solving strategies of the type Pólya described."[66]

60 [Untitled MS, n.d. "The organizers' choice of George Pólya."] George Pólya Papers, SC 337, 87-034, Box 2, ─P. R. Halmos, "The Heart of Mathematics," *American Mathematical Monthly,* Vol. 87, 1980, pp. 519-524.

61 Alan H. Schoenfeld, "George Pólya and Mathematic Education," Gerald L. Alexanderson, Lester H. Lange, "Obituary. George Pólya," *op. cit.,* p. 595. Cf. Rudolf Groner, Marina Groner, Walter F. Bischof, eds., *Methods of Heuristics* (Hillsdale, N.J., London: Lawrence R. L. Baum, 1983); Stephen I. Brown─Marion E. Walter, *The Art of Problem Posing* (Philadelphia, PA: The Franklin Institute Press, 1983).

62 Imre Lakatos to Dr. Maier (Rockefeller Foundation), Cambridge, England, May 5, 1957. George Pólya Papers, SC 337, 87-137, Box 1.─ In turn, Pólya expressed his admiration for Lakatos's "Proofs and Refutations," and recommended him as Professor of Logic at the London School of Economics and Political Science, "with special reference to the Philosophy of Mathematics." George Pólya to Walter Adams (LSE), Stanford, CA, January 13, 1969, George Pólya Papers, SC 337, 87-034, Box 1.

63 Alan H. Schoenfeld, "George Pólya and Mathematic Education," Gerald L. Alexanderson, Lester H. Lange, "Obituary. George Pólya," *op. cit.,* p. 595.

64 *Ibid*., p. 596.

65 Alan H. Schoenfeld, *Mathematical Problem Solving* (Academic Press, 1985)

66 Alan H. Schoenfeld, "George Pólya and Mathematic Education," Gerald L. Alexanderson, Lester H. Lange, "Obituary. George Pólya," *op. cit.*, p. 596.

IV Schooling

The outstanding success of education, and mathematics education in particular, underlines the significance of the Hungarian school system from the turn of the century until World War II. The secret of Hungary's émigré geniuses is partly the secret of Hungarian high schools before World War II and the result of a systematic effort in Hungary to develop an educational system along German lines. The Hungarian *gimnázium* was modeled upon the German *Gymnasium* and this was a studied effort on behalf of the new Hungarian government established after the Austro-Hungarian Compromise of 1867.

The German Gymnasium Imported

The architect of this admirable knowledge transfer was Mór Kármán, one of Hungary's most renowned educational experts, a pedagogical reformer and the father of Theodore von Kármán. Kármán Sr. came from a distinguished Jewish-Hungarian background, studying philosophy and classical philology at the University of Vienna and receiving his Ph.D. in Budapest in 1866. In 1869, the able young educational philosopher was commissioned by Minister of Religion and Education Baron József Eötvös to Leipzig, Saxony (in Germany), to study pedagogy and the modern theory and methods of training high school teachers, under the philosopher Professor Tuiscon Ziller (1817-1882), founder of the pedagogical seminar at Leipzig.[67] Upon returning from Germany in 1872, Eötvös's immediate successor, Tivadar Pauler (1816-1886), helped him introduce the German system in Hungary and found the Institute for Teacher Training at the University of [Buda]pest, as well as the "Practicing High School," or model *gimnázium,* for prospective teachers, thus profoundly influencing Hungarian education in a German spirit and tradition.[68] Mór Kármán himself became director of the school, which all four of his sons, including Theodore, attended.

Becoming Hungary's foremost expert on education, Mór Kármán was elevated to the Hungarian nobility in 1907,[69] and became a full professor at Budapest University in 1909. He belonged to the assimilated Jewish upper-middle-class of Hungary, and married into a well-connected family through which he was distantly related to the titled Jewish aristocracy of Hungary.[70] Mór Kármán felt himself close to Hungarian culture, and studied Hungarian literature.[71]

67 B. József Eötvös, Minister of Religion and Education to Mór Kleinmann, Buda, July 20, 1869. No. 12039, Theodore von Kármán Papers, 142.10, California Institute of Technology Archives, Pasadena, CA.

68 Baron József Eötvös to Mór Kleinmann, Buda, July 20, 1869, #12039, Theodore von Kármán Papers, California Institute of Technology Archives, File 142.10, Pasadena, CA; Untitled memoirs of Theodore von Kármán of his File 141.6, pp. 1-2. Cf. István Sőtér, *Eötvös József* [József Eötvös*]* (2. ed., Budapest: Akadémiai Kiadó, 1967); Miklós Mann, *Trefort Ágoston élete és működése* [The Life and Work of Ágoston Trefort*]* (Budapest: Akadémiai Kiadó, 1982).

69 Mór Kármán had some responsibility for planning the education of one of the Habsburg Archdukes and he received his title partly for this reason. Cf. William O. McCagg Jr., *Jewish Nobles and Geniuses in Modern Hungary,* Boulder, CO., East European Monographs, 1972, repr. 1986. s, p. 209, note 46—it was this title that Theodore von Kármán used in a Germanized form.

70 Theodore von Kármán, Untitled note on Mór Kármán, Theodore von Kármán Papers, 141.6, California Institute of Technology Archives, Pasadena, CA. Dr József Gerő, ed., *A Királyi Könyvek* [Royal Books] (Budapest, 1940), p. 100, William O. McCagg Jr, *Jewish Nobles, op. cit.,* p. 209. Péter Újváry, ed., *Magyar Zsidó Lexikon* (Budapest, 1929), pp. 453-454.

71 Mór Kármán, "Az Ember Tragédiája. Elemző tanulmány" [The Tragedy of Man. An Analytical Study] (*Bud-*

Some of the high schools developed under Kármán's oversight were connected in various ways with the University of Budapest. Graduating university students were expected to do their practice teaching in "model" high schools. High school teachers themselves were expected to do original research and be published regularly, both in- and outside of Hungary. The most eminent teachers were invited to give university courses; some even became professors and were elected members of the Hungarian Academy. The faculty of the best high schools in Budapest enjoyed a privileged position and high social prestige.

Defined by the act 1924:XI, high schools in Hungary were of three kinds: the *gimnázium*, the *reálgimnázium,* and the *reáliskola*. The *gimnázium* [high school] provided an all-round humanistic education, based primarily on studies in Latin and Greek language and literature. There were three types of *gimnázium* in Hungary: the regular *gimnázium* [high school] spanned over 6 years, the *algimnázium* [lower high school] 4 years, the *főgimnázium* [main or full high school] 8 years. The *reálgimnázium* [cca practical high school] added modern languages and literatures to Latin, while the *reáliskola* [cca practical school] gave a careful introduction to arithmetic and natural sciences and focused on modern languages alone.

The *gimnázium* was an élitist school for the select few. In Budapest, there were 38 high schools with around 16,000 students in 1914-15, 46 high schools with 21,356 students in 1929-30, and 81 high schools with 32,111 students in 1942-43. In 1929-30, there were only 7 *gimnázium*s with 3,482 boys and another 7 with 2,907 girls, 14 *reálgimnázium*s with 8,167 students, and 7 *lycée* type schools for girls with 3,262 students. Altogether, 3,250 students attended the 7 *reál*schools. Even in 1941-42, there were only 26 g*imnázium*s for boys and 7 for girls, with 10 *lycée*s, while the other 24 schools were industrial, agricultural, commercial, and business in nature.[72]

Most high school students came from the sheltered and privileged social background of a narrowly defined middle-class. For many years, these schools were all-male domains: the first *gimnázium* for girls was not opened in Austria until in 1892 and 1896 in Hungary. For socially aspiring Jewish students in particular, these schools acted as social equalizers, a much sought-after opportunity to integrate, emancipate, and assimilate into the emerging Hungarian "gentlemanly" middle-class. Upon reaching the age of eighteen, the state-controlled, uniform system of Hungarian final examinations brought high school studies to a demanding, challenging conclusion, and catapulted young men into the Hungarian elite.[73]

The choice by many Jewish students (or their parents) to attend various Christian denominational high schools in the early twentieth century was related to the phenomenon of religious

apesti Szemle, No. 346, 1905).—It is interesting to note that the Tragedy of Man was also a source of inspiration for other émigrée scientists, such as Leo Szilárd.

72 Miklós Horváth, ed., *op. cit.,* p. 480; Lajos I. Illyefalvi, *Budapest Székesfőváros Statisztikai és Közigazgatási Évkönyve* [Yearbook of Statistics and Public Administration for the Capital City of Budapest], Vol. XIX, 1931 (Budapest: Budapest Székesfőváros Statisztikai Hivatala, 1931), pp. 426-427; Lajos Illyefalvy, ed., *Budapest Székesfőváros Statisztikai Évkönyve* [Yearbook of Statistics for the Capital City of Budapest] Vol. XXXI, 1943 (Budapest: Budapest Székesfőváros Statisztikai Hivatala, 1943), pp. 346-347.

73 Viktor Karády, "A középiskolai elitképzés első történelmi funkcióváltása (1867-1910)," In: Viktor Karády, *Iskolarendszer és felekezeti egyenlőtlenségek Magyarországon (1867-1945). Történeti-szociológiai tanulmányok* [School system and denominational inequalities in Hungary 1867-1945. Historical-sociological studies] (Budapest: Replika Kör, 1997), pp. 169-194.

conversion. Though these schools were of exceptionally high quality,[74] sending children of Jewish origin to them expressed a willingness to assimilate. The Lutheran high school at Városligeti Fasor in Pest was a case in point, with dozens of extremely capable Jewish boys among the students every year. Notable examples were John von Neumann and prospective Nobel laureate Eugene P. Wigner. Teachers in these schools excelled in their field, as well as in the art of teaching, and several were recognized members of the scientific and scholarly community of Hungary.[75]

The number of Jewish students in the *gimnázium*s was 1,022 (out of the 2,806 who actually completed their schooling), and in the *reálgimnázium*s there were 1,956 (out of 7,806). Altogether, 3,408 boys and 2,122 girls were Jewish out of the total of 14,142 boys and 6,384 girls who completed high school of some sort. By 1941-42, the number of Jews who attended *gimnázium*s was 3,742 (out of 21,369), altogether totaling 4,365 Jewish students from an overall high school student body of 30,730.[76]

The Lutheran High School

John von Neumann and Nobel Laureate Eugene Wigner attended the Lutheran *Gymnasium* in Budapest, became two of its top students and in turn made it internationally recognized.[77]

The origins of the Lutheran *gimnázium* of Pest go back to the late 18th century.[78] The earliest motor behind the school was Lajos Schedius (1768-1847), the enlightened, Göttingen-educated professor of philosophy at the University of Pest whose anonymously published *Die Schule der evangelischen Gemainde A. C. in Pesth* (1816) emphasized the public nature of schools, and the importance of quality training of teachers, and spoke against the practice of mere recitation, calling instead for the emotional development of students. Much of the philosophy behind Lutheran education in Hungary came from the Swiss educator Johann Heinrich Pestalozzi (1746–1827).[79]

Lutheran schools mushroomed in the country; there were some twenty of them outside the city of Pest. The Pest school was so popular that it had to move to a new building in 1864 and then again in 1904. Erected in the *Városligeti fasor*, an elegant and fashionable street that runs parallel to Budapest's most prominent avenue, Andrássy út, the new building was one of the most up-to-date schools in contemporary Hungary. Designed by architecture professor Samu Pecz (1854-1922), the building was fully equipped with electricity and steam heating, 18 large class rooms, 14 cabinets for teachers and classroom demonstration material, dark rooms for experiments with light, film projection and photography, a six-room library, a five-room apartment for the director, a specially paved gym, and a huge community room for celebra-

74 John Lukács, *op. cit.,* pp. 142-146.

75 László Kovács, *Mikola Sándor* [Sándor Mikola] (2nd ed., Budapest: Országos Pedagógiai Könyvtár és Múzeum, 1995).

76 Lajos I. Illyefalvi, ed., *op. cit.,* pp. 426-427; Lajos Illyefalvy, ed., *op. cit.,* pp. 346-347.

77 Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda* [The Miracle in the Fasor] (Budapest: Országos Pedagógiai Könyvtár és Múzeum, 2002), pp. 66-109; Norman Macrae, *John von Neumann* (New York: Pantheon Books, 1992), pp. 61-84.

78 Victor Karády, "Juifs et luthériens dans le système scolaire hongrois." *Actes de la recherche en science sociales*, Vol. 69, 1987, pp. 95-110.

79 Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda, op. cit.,* pp. 8-9.

tions. By the beginning of the century, there were 12,000 volumes in the library, which subscribed to some 20-30 foreign journals, half of them in German and English. As of 1901-02, the supervisor of the library was no less a person than Sándor Mikola, the celebrated teacher of physics and prospective director of the school.[80]

The Lutheran Church of Hungary was convinced, however, that it was not the material equipment but the quality of the faculty that defined education. “Good teacher = good school” as the almost mathematical equation suggested in the school’s 1922-23 yearbook. Members of the faculty were near the level of university professors, with fourteen having graduated from the Eötvös Collegium, a Budapest version of the *École Normale Supérieure* in Paris, founded by Loránd Eötvös in 1895 to commemorate his father, Baron József Eötvös.[81]

Many of the best teachers also studied in Germany, among them Károly Bőhm (1846-1911), Gedeon Petz (1863-1943), János Loisch, Aurél Bászel (1845-1920), Sándor Dietze (b.1835), Rudolf Weber (1843-1915), and Róbert Fröhlich (1844-1894), who studied with Theodor Mommsen (1817-1903). Several of the teachers went on to become university professors, such as Dezső Kerecsényi (1898-1945), who later taught Hungarian literature in the University of Debrecen, botanist Sándor Sárkány (1906-1996) at the University of Budapest, mathematician Ágoston Schultz at the Technical University of Budapest; and the mathematician and physicist János Renner (1889-1976), who became the director of the Institute of Geophysics in Budapest. About two-thirds of the teachers in the *Fasor* regularly published in the most important (typically Hungarian) journals of their own field.[82]

Two important members of the faculty who had a major impact on John von Neumann were the mathematician László Rátz (1863-1930) and the physicist Sándor Mikola. It is enlightening to assess the source of their impact.

A member of the *Fasor* faculty for 35 years, László Rátz studied in the Lutheran *lycée* of Sopron, and the universities of Budapest, Berlin and Strassbourg. He treated all of his students equally and made them love his subject by demonstrating how best they could approach it at their own particular level. This highly individualized treatment brought the subject closer to students, irrespective of the nature of their own individual talent. He documented the practical aspects of mathematics and made its usefulness come alive. As editor of *Középiskolai Mathematikai Lapok* [High School Papers in Mathematics], he turned the school into a national center of mathematics teaching and made problem-solving into a national mathematics education program. He published the material of the first ten volumes in his *Mathematikai gyakorlókönyv* [Problem Book for Mathematics] in two parts (algebra and geometry), which became one of the basic textbooks of mathematical problem-solving worldwide. Many outstanding Hungarian mathematicians and scientists received their basic training in mathe-

80 Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda, op. cit.,* pp. 10-13.

81 The case of the Collegium clearly demonstrated that Hungary’s new intellectual élite was rooted not only in the middle- and upper-middle-class of Budapest but also in the provinces, thus producing at least two, often competing factions. The Collegium provided a framework for the training of an élite, with its pool of young people coming mainly from the Hungarian countryside. Cf. Victor Karády, “Le Collège Eötvös et l’École Normale Supérieure vers 1900. Note comparatiste sur la formation d’intellectuels professionnels.” In: Béla Köpeczi, Jacques Le Goff, eds., *Intellectuels français, intellectuels hongrois – XIIIe-XXe siècles* (Paris-Budapest: Akadémiai Kiadó–CNRS, 1986).

82 Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda, op. cit.,* pp. 13-18.

matics, and particularly mathematical problem-solving, through the work of László Rátz. As an acknowledgment of his role in modernizing mathematics education in 1909, he became the Hungarian member of the international committee for mathematics education and attended the congresses of Milan, Cambridge, and Paris. He was at his best when discovering, acknowledging, and nurturing talent and making his difficult subject generally well-liked and appreciated.[83]

As a teacher of mathematics, Rátz was a pioneer in introducing the elements of infinitesimal calculus and made the concept of *the function* a central aspect of his teaching. He published his new educational ideas along with colleague Sándor Mikola in 1910 under the title *Az infinitezimális számítások elemei a középiskolában* [Elements of infinitesimal calculus in the high school][84] which they later published in a new, improved edition as *A függvények és az infinitezimális számítások elemei* [Elements of function and infinitesimal calculus][85]

Like his friend László Rátz, Sándor Mikola was also a student of the Lutheran *lycée* of Sopron and of the University of Budapest where he studied with the Eötvös-student János Renner and met Loránd Eötvös himself. He became a teacher at the Lutheran *gimnázium* in 1897 and remained a member of the faculty until his retirement in 1935. He was director of the school between 1928 and 1935, and co-editor, with Lipót Fejér, of *Mathematikai és Fizikai Lapok* [Papers in Mathematics and Physics].[86] Mikola was an active experimental physicist whose studies on electricity were rewarded with a membership of the Hungarian Academy of Sciences in 1923. He was an enthusiastic teacher and educator, who loved his work as well as his students. He thrived when free to choose his working methods and put into application exact scientific terms such as the notion of development, the use of analogies and the creation of models.[87] For him, the notions of physics were born and developed rather than merely existing in a physical form: physical reality is the result of a process and not an existing set of facts. The teaching of physics started with either qualitative or virtual experiments, which helped students to develop their notions of physics. Mikola was enthusiastic about the inductive and heuristic method, which he believed was especially created for physics.[88]

> By applying appropriate questions the teacher tries to direct the thinking of his students to the subject, to help the subconscious experiences and making their instinctive mechanical notions conscious, to turn the direction of their thinking toward selecting the important, to develop their ability to observe and analyze, to enlighten the development of abstract physical notions and keep their interest in the subject by inspiring the necessary stimuli constantly awake…[89]

He developed his principles of physics over the writing of several books such as *A physikai alapfogalmak kialakulása* [The development of the basic terms of physics] (1911), *A fizika*

83 For Rácz' biography see Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda, op. cit.,* pp. 27-45.

84 Budapest: Franklin, 1910.

85 2nd ed. Budapest: Franklin, 1914.

86 For a biography of Mikola see László Kovács, *Mikola Sándor*, *op. cit.,* especially pp. 5-7; Krisztina Dobos, István Gazda, László Kovács, *A fasori csoda, op. cit.,* pp. 46-65.

87 László Kovács, *Mikola Sándor, op. cit.,* p. 21.

88 László Kovács, *Mikola Sándor*, *op. cit.,* pp. 22-24.

89 Quoted by László Kovács, *Mikola Sándor, op. cit.,* p. 25.

gondolatvilága [The mind of physics] (1933) and *A fizikai megismerés alapjai* [The basics of physical cognition] (1941), which brought him full membership of the Academy by 1942.[90]

The Model School of the University

The *Mintagimnázium* [model high school], founded and first directed by Mór Kármán, was best described by his son Theodore von Kármán, himself a student of this school.

> The Minta, or Model Gymnasium, was the gem of my father's educational theories. It was designed to be directed by a professor at the University but to maintain an independent status. It became the model for all Hungarian high schools and today is quite famous in Hungary, though little known in the West. Recently, however, its high standing over the years was noted by a writer for the London *Observer*, who called the Minta a "nursery for the elite," and compared it with such schools as Eton for Conservative M.P.'s and [the Institut] Le Rosey [in Switzerland] for ex-kings and socialites. The Minta graduated two of Britain's top economists, Dr. Thomas Balogh of Balliol College (a son of one of my cousins) and Nicholas Kaldor of King's, Cambridge. …[91]

As in all the *gimnázium* throughout Hungary, Latin was of paramount importance. Until the end of 1844, Latin was the state language of Hungary and educated people were all expected to read and write classical Latin. The study of Latin was also viewed as being useful for training the mind, strengthening the memory, and introducing the student to a complex system: Latin grammar.

> For me the Minta was a great educational experience. My father was a great believer in teaching everything—Latin, math, and history—by showing its connection with everyday living. In our beginning Latin class, for instance, I remember that we did not start with rules of grammar. Instead we were told to walk around the city and copy the Latin inscriptions on statues, churches, and museums. There were many of these to be found, since Latin was the official language in Hungary until 1848.[92] When we had collected the phrases and brought them to class, the teacher asked us which words we already knew. We usually could recognize a few words among the phrases. If we didn't, we looked them up. Then he asked us if we recognized the same word in different forms. Why were the forms different? Because they showed different relationships to other words in the inscription. We continued in this way until we understood each phrase and why it was placed on the monument. As a result of this practice, we all accumulated a Latin vocabulary which we retained and we deduced some fundamental rules for inflection of the Latin word. We also learned something of Hungary's past.[93]

Theodore von Kármán remembered fondly his mathematics classes which also were based on inductive methods and related to practical life. (Another future celebrity from Budapest, Edward Teller, profited from these same classes.) Von Kármán drew an important parallel

90 László Kovács, *Mikola Sándor*, *op. cit.,* p. 57.

91 Theodore von Kármán with Lee Edson, *The Wind and Beyond: Theodore von Kármán, Pioneer in Aviation and Pathfinder in Space* (Boston—Toronto: Little, Brown and Co., 1967), pp. 20-21.

92 Until the end of 1844 only. TF

93 Theodore von Kármán with Lee Edson, *The Wind and Beyond, op. cit.,* p. 20.

between his classes in Latin and in mathematics, the two cornerstones of Hungarian education in the *gimnázium*.

> Mathematics, which I now studied eagerly, was taught in terms of everyday statistics and it had a fascination for me all over again. For instance, we looked up the figures on the production of wheat in Hungary for several years. We set up tables and then drew graphs, so we could observe the changes and locate the maximum and the minimum wheat production. In the diagrams we searched for correlations, and we learned about "the rate of change," which brought us to the edge of the calculus. We thus learned in a practical way that there was a relationship between quantities that varied, and, as with Latin, we learned at the same time something of the changing social and economic forces in the country.
>
> At no time did we memorize rules from the book. Instead we sought to develop them ourselves. I think this is a good system of education, for in my opinion how one learns the elements of reasoning in primary school will determine his later capacity for intellectual pursuits. In my case the Minta gave me a thorough grounding in inductive reasoning, that is, deriving general rules from specific examples—an approach that remained with me throughout my life.[94]

Mór Kármán was also a pioneer in initiating "practice teaching" in his school, regularly inviting graduating university students from various disciplines to acquire practical experiences for their future careers as high school teachers.

> In addition to introducing what were then novel methods of teaching, my father also started at the Minta the system of practice teaching by university graduate students. Some educators opposed this plan: it would expose us to inexperienced teachers, the *koca* (sows) as we high school students ungraciously called them. My father, on the other hand, firmly maintained that students would find it an advantage to learn as early as possible to distinguish between good and bad teaching.

The *Minta* (Model) school also provided a more democratic model, regarding especially teacher-student relations, which in most Hungarian and Austrian schools were traditionally rigidly formal and inpersonal.

> The Minta was the first school in Hungary to put an end to the stiff relationship between the teacher and the pupil which existed in the Empire [the Austro-Hungarian Monarchy] at the time. In the corridors of the Minta the teachers moved constantly among the pupils. Contrary to the practice in other high schools, students could talk to the teachers outside of classes and could discuss matters not strictly concerning school. The charter of the Minta declared in writing for the first time in Hungary that a teacher might go so far as to shake hands with a pupil in the event of their meeting outside class.[95]

The University of Hungary

In the 18th and 19th centuries the Central European university was strongly influenced by the Prussian/German model, and particularly by the ideas and activities of Wilhelm von Humboldt (1767-1835). Von Humboldt persuasively argued for a university that the State of Prus-

94 Theodore von Kármán with Lee Edson, *The Wind and Beyond, op. cit.* pp. 21-22.
95 Theodore von Kármán with Lee Edson, *The Wind and Beyond, op. cit.,* pp. 20-22.

sia should possess, and his vision of a state-run university had a wide impact not only in the various states of Germany but also throughout Central/East-Central Europe. „The Prussian State," he declared when lobbying for the University of Berlin in 1810, „has no other means, and no state may possess a nobler one to distinguish and honor itself than through the loving support of the sciences and arts." Culturally speaking, East-Central Europe has always been on the fringes of Germany, heavily influenced by German ideas, German art, German science and German scholarship. The Central European university cannot be understood without the proper study of, and a comparison with, its German opposite numbers. Hence their high quality, their competitive edge, but also their strictly hierarchical nature and authoritarian philosophy. Particular forms of teaching such as the seminar as we know it even today spread largely from Germany, particularly from the University of Berlin where famous scholars like the historian Leopold von Ranke (1795-1886) introduced and developed it for an intellectually elitist consumption.

The most important university in Hungary has for a long time been Eötvös Loránd University of Budapest, named after the one time Rector of the University, Loránd Eötvös.[96] One of the top fifteen universities of the world at the end of the 19th century, this university awarded John von Neumann his doctorate in mathematics in 1926. The oldest Hungarian university currently in service, the university was founded as a Jesuit institution by Péter Cardinal Pázmány (1570-1637) in 1635 in Nagyszombat (today Trnava in Slovakia). At a time when much of Hungary was still under Ottoman occupation, Pázmány expressed his desire to move his University of Hungary *(Universitas Hungariae)* in the future from the small city of Nagyszombat to a more suitable location after the liberation of the country. In the meantime he entrusted the university to the Jesuits of Nagyszombat and designed it as a center of the entire educational system of Hungary. International in its ideological foundations, Pázmány's work was instrumental in preserving Hungarian national culture at a time when Hungary was dominated by a major foreign power. This indeed signaled the recurring double function of higher education in not only Hungary but in many different areas of Europe: it served both cosmopolitan and national functions and interests.

When the Jesuit order was dissolved by Pope Clement XIV [Pope from 1769 to 1774] in 1773 *(„Dominus ac Redemptor noster")* it was the Empress Maria Theresa [Empress from 1740 to 1780] who moved the university to Buda (much later, in 1873, to become a part of Budapest) in 1777 and tried to include it (as well as all other universities of her Empire) into a Habsburg system. The Empress made every effort to make this as well as all the other imperial universities resemble the University of Vienna: *„Universitati Vindobonensi per totum conformentur"*. In the history of the university this was one of the many subsequent steps towards centralization. Her son, the Emperor Joseph II went even further when making the University one of his many government offices, which ultimately simply denied the university faculty and the academic leadership any interference in university matters: *„nec decanis facultatum, nec magistratui academico aliquis influxus in res litterarias concedendus est"*. These ideas and efforts started a long tradition of state intervention in the entire area that came

96 Kornis Gyula, szerk., *A kir. Magyar Pázmány Péter Tudományegyetem alapítása 300 éves évfordulójának jubileumi évkönyve* [Yearbook of the Royal Hungarian Pázmány Péter University on the 300-years-jubilee of its foundation] Budapest: Kir. M. Egyetemi Nyomda, 1936), pp. 54-57; Pázmány személyisége [The personality of Pázmány], in: Kornis Gyula, szerk., *op. cit.,* pp. 121-180.

gradually to replace church governance and have lasted indeed until today. Practically no government in Hungary ever tolerated the autonomy, let alone sovereignty of the universities and tried to place them under the tutelage of the state. This ideology was made into a compact philosophy by the German philosopher Georg Wilhelm Friedrich Hegel (1770-1831) and his vision of the state as an absolute (in the words of Thomas Mann, *„Staats-Verabsolutierung"*).[97] Not even the ministry of the democratic revolution of 1848 restored the autonomy of the university, ordering it under the direct control of the minister of education. One must add that the language of tuition was Latin until the very end of 1844 when it was belatedly replaced by Hungarian.

Without even trying to present the complete history of this one university as a case study, it is imperative to note that all this was done to the University of Hungary centuries before Communism: practically all subsequent (and very different) political regimes took a nearly absolute control over this institution of higher learning. The foundations of centralization, anti-democratic leadership, ideological control, and the direct interference of the state were all there in the early history of this great institution.

This once so famous institution suffered the consequences of merciless state interventions under the Communist regime, particularly between 1949 and 1956. A school that at the end of the 19th century belonged to the top fifteen universities of the world is today in the 301-400 range of the Shanghai academic ranking of the top 500 world universities (provided by the Jiao Tong University), was Nos. 376-377 on the list of *The Times Higher-QS World University Rankings 2006*, and No. 351 on the *Webometrics* list in January 2007.[98]

V Fascination with Science

Several economic and social factors contributed to the emergence of the high level in science and science education at the time of the rise and fall of the Austro-Hungarian Monarchy. In a country where the long decay of feudalism had become visible and the political and social system based on huge landed estates had come under sharp attack, the beginnings of a new, capitalist society stimulated work in science, technology, and the arts. The transformation of the Habsburg Monarchy and the creation of a "Hungarian Empire" contributed to an economic prosperity that brought about a building and transportation boom, the advancement of technology, and the appearance of a sophisticated financial system. The rise of a new urban middle-class affected the school system.

Modern Hungarian science was rooted in the highly selective and élitist educational system of fin-de-siècle Hungary's high schools, the competitive spirit introduced in mathematics and science education in the form of high school competitions and journals specialized in high school mathematics and physics. Members of the high school faculties were, at least in the very best schools, outstanding science educators and outstanding scientists themselves, several of them close to the level of university professors. The Liberal spirit of much of the era contributed to the relatively high degree of the freedom of teaching and learning. The denom-

97 Thomas Mann, *Schopenhauer* (Stockholm: Bermann-Fischer, 1938), p. 60.
98 ed.sjtu.edu.cn/ranking.htm; www.answers.com/topic/college-and-university-rankings; www.webometrics.info

inational high schools played an important role, though usually with a limited role on religious education and a greater emphasis on free thinking.

The strong attraction of some of the best German universites played a major role in Hungary. Berlin, Göttingen, Heidelberg and other German centers of learning lured subsequent generations of outstanding Hungarian students and had a strong impact on Hungarian science and science education. The German cultural and scientific background prevailed throughout Hungary, where German as a language was widely used in the period of the Austro-Hungarian Monarchy. German culture permeated most branches of Hungarian civilization, which developed for a long time, as it were, on the fringes of the great German world of education, science, and culture.

The end of the period came right after World War I. Hungary, within the Austro-Hungary, was one of the loosers of the War amd had to suffer the consequences: two revolutions, a counter-revolution, the Peace Treaty of Trianon (1920), and the *Numerus Clausus* act of 1920. Hungarian society underwent momentous changes, loosing vast territories, large groups of ethnic *Magyars*, experiencing decline and initiating the disastrous policy of revisionism which attached the country to Germany and its allies. The golden age of Hungarian development was over.

Popularization of Science in Poland before and after the Collapse of the Soviet Bloc*

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Within a few years after the collapse of the Soviet Bloc in 1989, printed channels for the popularization of science in Poland had changed dramatically. Old periodicals for conveying scientific knowledge to the laity became extinct and new titles emerged. Newspapers rearranged their science sections. And the market for popular science books experienced an earthquake. In this paper I present a preliminary analysis of these changes, keeping in mind that the weakness of this account is the attendant tendency to equate description with explanation.

In the early 1970s Poland was one of the world's fastest growing economies. But this "economic miracle" was the result of massive imports of industrial equipment from the West, financed by Western credits. The result was the largest foreign debt in Eastern Europe, which could be serviced only by raising prices and squeezing living standards. In August 1980 mounting Polish resentment resulted in the formation of an independent trade union, Solidarity. Under the leadership of Lech Wałęsa, Solidarity became a potent political force, although the country was still a member of the Soviet Bloc. In December 1981 Prime Minister General Wojciech Jaruzelski proclaimed martial law. A few thousand Solidarity leaders were arrested and Solidarity was suppressed. Martial law ended officially in July 1983. By 1987 the Polish government was in crisis and put forward plans for the limited decentralization of the economy. In 1989 the government began round table talks from which Solidarity emerged as the dominant political force. These produced an agreement on a new constitution and the legalization of multi-party politics. These fundamental changes initiated the demise of the Soviet Bloc; at the end of 1991 the Soviet Union ceased to exist and was replaced by a loose Commonwealth of Independent States.

This political breakthrough in Poland resulted in the transformation of mass communications and the publishing business. At the beginning of political changes the following factors could be recognised: the abolition of press licensing in May 1989; the suppression of the press monopoly controlled by the Communist Party in March 1990; the abolition of censorship in June 1990; and the Broadcasting Act which regulated the launch of private commercial radio

* This paper is a slightly revised version of my presentation at the symposium "Communicating Science in 20th Century Europe: Comparative Perspectives" held at the 23rd International Congress of History of Science and Technology, 28 July – 2 August 2009, Budapest.

and television stations, adopted by the Polish Parliament in December 1992. Considerable changes on the press market ensued. At the beginning of the 1990s several new dailies were created in Poland. After a few years almost all of them disappeared, however, and the only ones that remained on the market were those newspapers people had become accustomed to in the 1980s. At the end of the 1990s the number of national dailies of general interest decreased by half. Simultaneously, the length of dailies increased several times: from an average of 6–8 pages in 1989 to several dozen at the end of the 1990s. On the magazine market dozens of foreign titles appeared in Polish-language versions like, for instance, *National Geographic* and *Playboy* from the United States, *Elle* from France and *Burda* from Germany. Among these were two popular science magazines: *Świat Nauki*, the Polish version of *Scientific American* (published in Poland since 1991), and *Focus* (since 1995).[1] Last but not least, on the book market private publishing houses flourished and the number of publishing houses increased considerably.

Poland also witnessed an accelerated increase of the number of institutions of higher education, most of them non-public. For instance, in the academic year of 1990/91 there were 96 institutions of higher education, all public, whereas in the academic year of 2002/03 – 377 institutions of higher education existed,[2] 125 of which were registered as public and 252 as non-public.[3]

Taking into account the background presented, in this paper I try to follow the changes that took place in printed channels for the popularization of science in Poland in the 1980s and 1990s, concentrating on the market of popular science books, popular science monthlies, and newspapers, and disregarding the very interesting case of weeklies.

Popular Science Books

According to data gathered by the Bibliographic Institute of the National Library and published by *Statistical Yearbook*,[4] the number of book titles printed in Poland increased twofold between the beginning of 1980s and the beginning of the 21st century, as can be seen from Figure 1. Figure 1 presents three types of books:

(i) scientific publications, not including textbooks;

(ii) popular publications, not including textbooks or fiction, but including professional and popular science publications;

(iii) belles-lettres.

1 "Media System in Poland. An Overview of Transformation," Press Research Centre, http://www.obp.pl/03-raport/2001/media_system_in_poland.htm.

2 Including universities, technical universities, agricultural academies, academies of economics, teacher education schools, medical academies, academies of fine arts, and theological seminaries.

3 *Statistical Yearbook*, vol. 51 (1991), Warsaw, 1991; *Statistical Yearbook of the Republic of Poland*, vol. 63 (2003), Warsaw, 2003.

4 *Statistical Yearbook* and *Statistical Yearbook of the Republic of Poland* for the subsequent years; see ref. 2.

This trend can be easily explained. Responsible for such great growth was an accelerated increase in the number of publishing houses and, especially with reference to scientific publications, of institutes of higher education.

Statistical Yearbook also gives us information concerning print runs in Poland. This allows us to calculate an average print run in the period in question. Figure 2 presents the average print run for three types of titles: belles-lettres, scientific publications, and popular publications. We can see that maximum print run for all three types of books appeared in the 1980s, and then systematically dropped off. It is consistent with the observed growth in the number of titles: since the population of Poland did not increase in this period, the number of printed copies should remain approximately on the same level.

To check whether these trends were representative for the genre of popular science, we analyzed a history of four leading popular science series in Poland. Biblioteka Problemów was published from 1956 on, and the total number of printed titles amounts to 293; the last appeared in 1990. Throughout most of its history titles published in the series were hardbacks of good quality. The first title in the Omega series was launched in 1964, and the last in 1995. Total number of Omega paperbacks amounts to about 420. Books in the Omega series were shorter and considerably cheaper than those of Biblioteka Problemów. Biblioteka Myśli Współczesnej flourished on the Polish market in 1970, and is still published. In 2008 the number of published titles exceeded 320. Books in the series are typical paperbacks. These three series were published by state-owned companies, respectively, Polskie Wydawnictwo Naukowe (PWN), Wiedza Powszechna (WP), and Państwowy Instytut Wydawniczy (PIW). After 1989 only PWN changed its status and became privatized, but this was not until Biblioteka Problemów had already ceased to exist. The fourth series, Na ścieżkach nauki, was created in 1995 in the private publishing house Prószyński i S-ka. By 2008 114 titles had been published in this paperback series. Biblioteka Problemów, Omega, and Biblioteka Myśli Współczesnej all printed titles devoted both to science and humanities, although the last contained mainly books on the social sciences; Na ścieżkach nauki is dedicated to science.

Figure 3 presents the average number of titles per year published for consecutive decades in the four series mentioned . We can see that the highest numbers were in the 1960s and 1970s, and in the next decades they decreased systematically to the level of a few titles per year. In other words, popular science publishing in the 1980s and 1990s in Poland behaved differently from other genres. Thus we can assume that a few titles per year is typical for a popular science series in Poland. It was also the reason why PWN ended publication of the Biblioteka Problemów series. The publisher had become accustomed to considerable print runs in earlier decades and realized too late that the market had changed and new ways of selling books were needed.[5] We can also hypothesize that Biblioteka Myśli Współczesnej survived owing to the fact that titles published in this series were often treated as recommended reading for students of humanities and social sciences. And the disappearance of Biblioteka Problemów and Omega enabled the new Na ścieżkach nauki series to achieve success.

5 Anna Szemberg, a manager at PWN, in private conversation, July 2009.

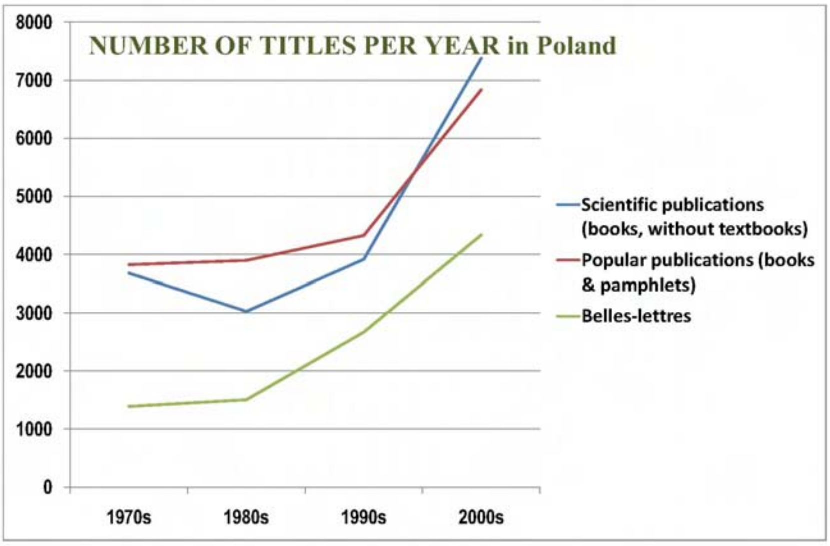
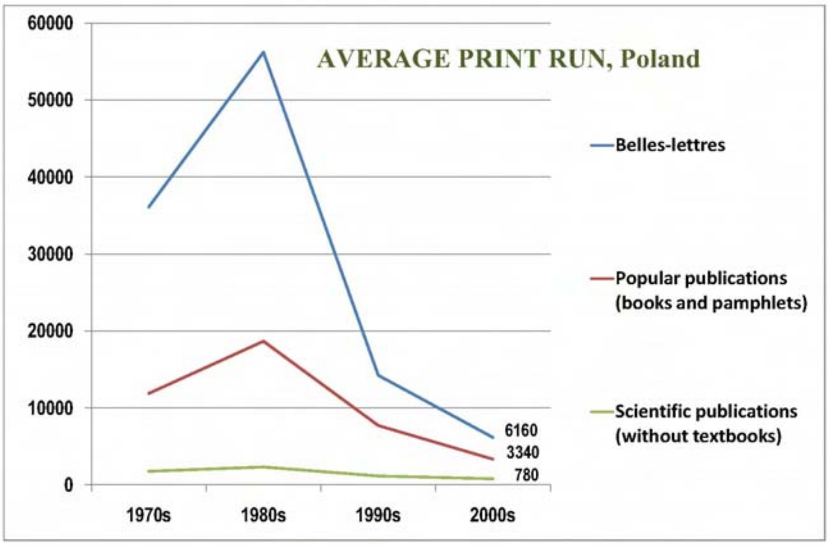


Fig. 1.



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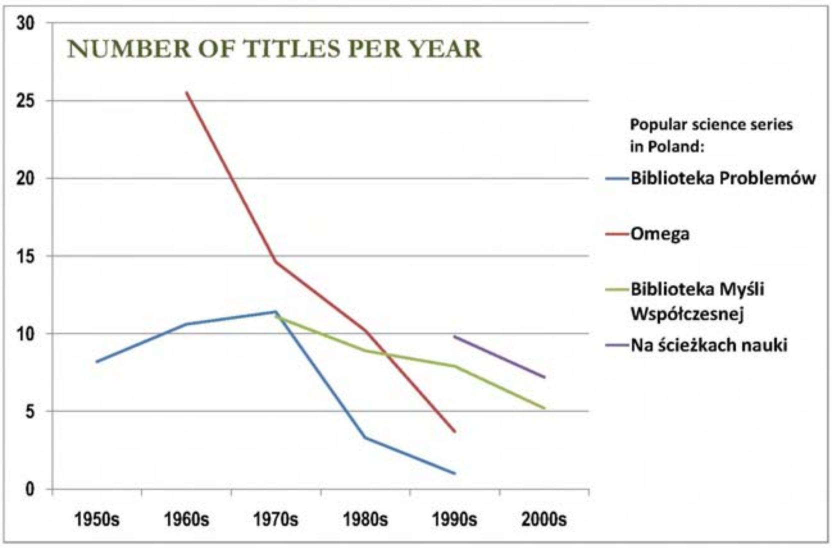


Fig. 3

Popular Science Monthlies

Before 1990, the political party publishing house RSW controlled 92% of daily circulation and about 60% of magazine circulation.[6] In 1990 the publishing house RSW went into liquidation, and rights to some of the press titles were transferred to members of editorial teams who formed a sort of journalists' cooperative. It was the fate of two leading popular science monthlies, *Problemy* and *Wiedza i Życie*. Both titles appeared on the market immediately after the Second World War (in fact, *Wiedza i Życie* has an even longer tradition), and in the 1950s and 1960s *Problemy* was extremely popular. Its circulation reached over 100,000 copies, making it more than, for example, the circulation of *Scientific American* or Russian *Nauka i Żyźń*, if we take into account the relative populations of Poland, USA, and the Soviet Union.[7] *Problemy* and *Wiedza i Życie* published articles written by Polish authors, and the range of subjects was very wide, from humanities to science. In the 1970s *Problemy* changed its contents, introducing a huge section of translations from foreign popular science magazines and publishing a science fiction story in each issue.

Before 1989 both *Problemy* and *Wiedza i Życie* were black and white magazines. *Wiedza i Życie* was transformed into a colorful monthly at the beginning of 1989, a year before the publishing house RSW went into liquidation. It was a tremendous success; the circulation of *Wiedza i Życie* exceeded 100,000 copies.[8] *Problemy* did not change its layout, and was printed in a circulation three to four times lower than *Wiedza i Życie*. However after the transformation of media in 1990, both journalists' cooperatives were unable to manage on their own. In 1992 *Wiedza i Życie* was sold to the private publishing house Prószyński i S-ka (its circulation in this time amounted to about 80,000), and the last issue of *Problemy* appeared in May 1993 (between ten and twenty thousand copies were printed).[9]

During the same period, since 1991, *Świat Nauki*, the Polish version of *Scientific American* had been published. This title was introduced on the market by editors of *Wiedza i Życie*, and shared its fate, since it was bought along with *Wiedza i Życie* by Prószyński i S-ka. Both *Świat Nauki* and *Wiedza i Życie* are still on the market, although in 1995 the German media house Gruner und Jahr began publishing *Focus*, which is now the leader among popular science monthlies in Poland.

Newspapers

In the 1980s the average number of pages in newspapers in Poland amounted to 6–8. Usually a national daily of general interest had a section on science and technology. Let us use the examples of two national dailies, *Życie Warszawy* and *Rzeczpospolita*. In both cases information about the existence of science and technology section was placed in an imprint. And in

6 "Media System in Poland. An Overview of Transformation" (ref. 1).
7 J. Hurwic, "Z historii *Problemów*," *Problemy* No. 12 (1992), 37–39.
8 From personal experience; the author was a member of the editorial board of *Wiedza i Życie*.
9 Adam Zubek, a member of the editorial board of *Problemy*, in private conversation, July 2009.

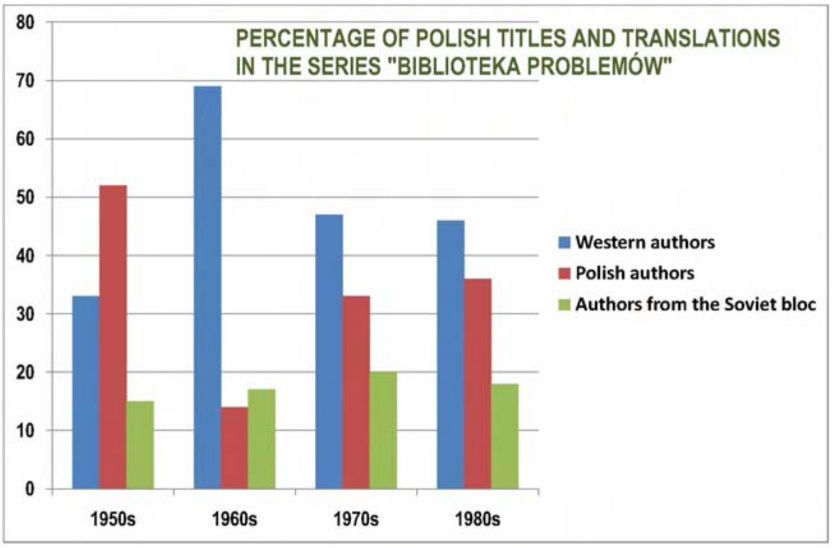
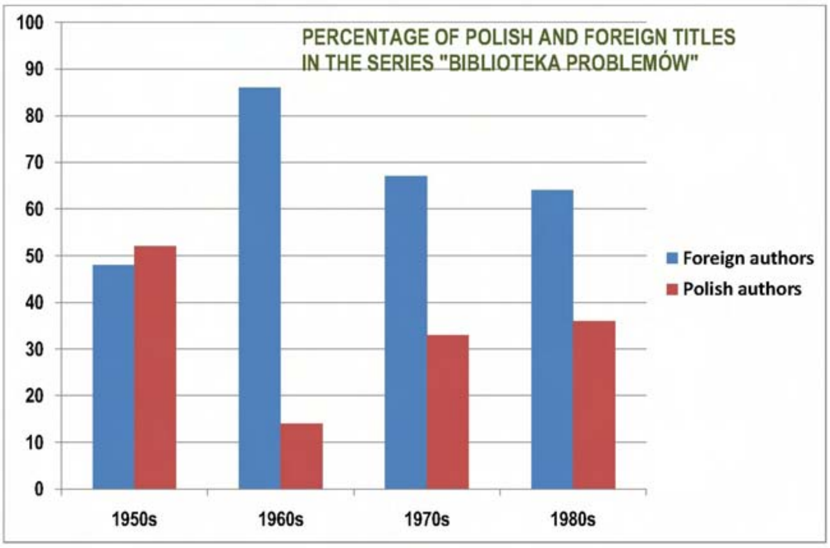


Fig. 4



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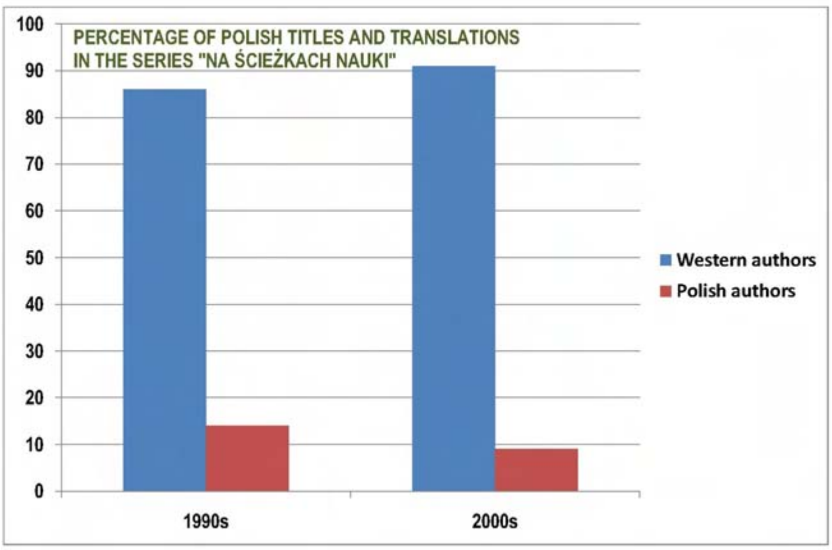

Fig. 6

both cases science news appeared scattered on different pages. However, in the case of *Życie Warszawy* the science and technology news was also sporadically grouped together in a page under the aegis "Science and Technology." This changed between 1989 and 1990.

In 1990 we would not find the science and technology section on pages of *Życie Warszawy*, but a lot of space is devoted to the enterprise and economy section, which appears almost every day. In 1991 a section titled "Civilization" was introduced, but as a weekend supplement. The popularization of science was represented by light repertoire here—more on beauty than particle physics or biochemistry. And in 1992 science disappeared from the imprint.

In *Rzeczpospolita* the science and technology section disappeared in January 1991, and science was attached to the culture section. Popular science texts were published sporadically in a weekend supplement. But this changed again in August 1992, when a two-page supplement began appearing, published once a week, on Thursday.

Certainly the first period of transformation in Poland was not good for the popularization of science in newspapers. This observation is confirmed by the evolution of another daily, *Gazeta Wyborcza*. Its founding was an outcome of the Polish Round Table Agreement between the Communist government and political opponents centered around the Solidarity movement. It was the first legal newspaper to be published outside the Communist government's control since the end of the Second World War. According to the editors, the first edition was small—150,000 copies—due to the limited supplies of paper available from the state. A year and a half later, the daily run had reached 500,000 copies.

From the first edition in May 1989 to February 1993 there was no regular science news in *Gazeta Wyborcza*. Eventually the science section appeared in March 1993 in a weekend supplement to *Gazeta Wyborcza*, but did not find its way into the main edition until December 1993. From this time the science section in *Gazeta Wyborcza*, together with such a section in *Rzeczpospolita* that appeared in the main edition from August 1992 on, serve as a point of reference for other Polish newspapers with science departments.

Concluding Remarks

Even this cursory analysis reveals that in Poland in the 1980s and 1990s printed channels for the popularization of science experienced great changes under the influence of new political and economic factors. To show this I tried to gather some empirical data, although it should be remembered that we do not operate within a static grid of parameters. And in the case of Poland it is not so easy to comb out tangled political and economic influences. Certainly both the press and the market for books no longer depend directly on political factors.

I have not touched on the subject as to how the goals, rhetoric, and people involved in this process changed during the period of transformation. We should keep in mind, for instance, that in the 1990s a new generation of science writers emerged in Poland; now they are oriented toward Western types of the popularization of science. For a historian of science it would be particularly interesting to reveal the role of Polish scientists and universities in the transformation of popular science between 1980 and the beginning of the 21st century. Some useful information on this subject can be obtained, for example, from a quantitative analysis of the number of authors who wrote books for popular science series. Figures 4 and 5 present the percentage of Polish and foreign authors in the Biblioteka Problemów series (in Figure 5 Western authors and authors from the Soviet Bloc were treated together), whereas Figure 6 gives us the same material for the Na ścieżkach nauki series.

We can see that the process of growth of the number of Polish authors in the 1970s and 1980s, observed in the Biblioteka Problemów series, had no continuation in the 1990s or later in the Na ścieżkach nauki series. Why did this happen? At the moment we know far too little about the transformation of popular science between 1980 and the beginning of the 21st century in Poland to answer this and other questions. However, there is a chance that this symposium will give an impetus to the study of the popularization of science in Poland in the 20th century, and that these researches will contribute to ongoing debates on the popularization and popular sciences in the broader context.

Science Communication as Political Tool

A Soviet Scientific Public Sphere

From Lenin to Khrushchev's Times in Soviet Russia, 1917-1964*

James T. Andrews

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This is the attempt to outline very briefly my past and present research on Soviet popular science which may serve as a starting point for a discussion on comparative research perspectives with other European developments of popular science and its political uses. I will in particular refer to the following two books of mine

- *Science for the Masses: The Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917-34*, College Station: Texas A & M, 2003
- *Red Cosmos: K. E. Tsiolkovsksii, Grandfather of Soviet Rocketry*, College Station: Texas A & M, 2009

In addition there are the edited volumes

- *Maksim Gor'kii Revisited: Science, Academics and Revolution*, 1995
- *Into the Cosmos: Space Exploration and Soviet Culture*, co-edited with Asif Siddiqi, to appear 2011

The Argument

In the late eighteenth and early nineteenth century, Imperial Russia experienced a reading and publishing revolution outside the state's purview. Enlightened publicists, such as the freemason Nikolai Novikov, built entire enterprises around publishing popular scientific tracts and textbooks for commoners in the hope of expanding their scientific horizons. By the late nineteenth century, scientific societies, the Academy of Sciences, popular editors, and pedagogues became involved in a vast movement to popularize science throughout the Russian empire. Educational specialists were particularly interested in how to craft popular scientific texts, and how to envisage their audience and targeted readers. The movement was as much about the content of popular science tracts as it was the method of popularizing this material to a broad audience.[1]

* I would like to thank Arne Schirrmacher for inviting me to contribute to this survey of research on science communication in 20th century Europe (and EurAsia) and to join the group that was set up at the 2009 Budapest symposium.

1 For an analysis of the generative and discursive process of science popularization in late imperial and revolutionary Russia, see James T. Andrews, "N. A. Rubakin and the Popularization of Science in Russia," *Russian*

With the aftermath of the 1917 Bolshevik Revolution, something had dramatically changed the landscape for science popularizers. Many now found the new Marxist state a willing supporter of their goals of spreading science to an under-educated public – the state, at least until 1928, sponsored pre-revolutionary editorial boards, museums, scientific societies, and even individual publicists that helped in this cultural revolution that fit the broad goals of the early European enlightenment and more imminent cultural revolution of Lenin's Communist Party in the 1920s.[2] This was true not only in the central provinces and capitals of Soviet Russia, but in provincial settings at well – the Bolsheviks therefore wanted to especially use the pre-revolutionary scientific elite in their mass educational campaigns, particularly in areas like the provinces where their political foothold was still tenuous.[3]

Fig. 1: Demonstration of the technical society "Aviation and Chemistry", 1933
(Archive of Russian Academy of Sciences ARAN, fond 555, op. 2, d. 149, 1.3.)

With Stalin's Industrial and Cultural Revolution from above in 1928, something dramatic though would change for the science popularization movement in Russia. In the Stalin era, Soviet state officials believed that the spread of science and technology had to coalesce with the Communist Party's utilitarian goals and needs to revive the industrial sector of the eco-

History/Histoire Russe, Vol. 16, no.1, 1989.

2 For an overall analysis of this broad process, see James T. Andrews, *Science for the Masses: The Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917-1934* (College Station: Texas A & M University Press, 2003).

3 For a case study of provincial science popularization as a process using the case studies of the upper Volga River basin, see James T. Andrews, "Iaroslavl Naturalists and the Soviet State, 1917-1931," in Donald J. Raleigh, *Provincial Landscapes: The Local Dimensions of Soviet Power* (Pittsburgh, 2002).

nomy. This resulted in a new Stalinist technologically oriented popularization campaign that reflected the emphasis on Soviet technology and its glorification vis-à-vis the West. In essence, the enlightened, imaginative vision of public science that crossed the 1917 divide became transformed after 1928 into applied science and technology for the masses especially at the laboring worksites.

With the Second World War, and its devastation of the Soviet public, popular educational campaigns, especially in the sciences, took a backseat to the industrial, economic and mass-psychological rehabilitation of the former USSR. However, with the launching of Sputnik I in 1957 (and the earlier acquisition of a nuclear bomb and its successful detonation in the Central Asian Steppe in 1949), Soviet politicians became increasingly more aware of the competitive power of Soviet technology, and developed extensive campaigns to publicize (through press releases both domestically and internationally) Soviet feats for a broad Soviet and foreign public audience.

An Outlook

Since I would argue that big science and technology therefore became the overriding tropes that the regime-driven publicist campaigns emphasized, and Soviet feats in outer space were particularly popular during the Khrushchev era,[4] this project will lead to an analysis of the popular ramifications of big science and technology in the context of the ensuing cold war – especially the types of themes popularized and their meta-narratives. I will also try to show, furthermore, that these themes were not simply regime-driven from above, but also still (even in the 1950s and 1960s) reflected the genuine interest from below by ordinary Russians in scientific and technical issues. Therefore a synthesis and symbiosis would exist between propagandistic regime and its public – even under censored conditions like in the former USSR.

After 1957, as part of a myriad of celebratory events in honor of Sputnik's launching, a host of journals and newspapers (including the military's "Red Star") published laudatory articles on Soviet rocketry, the history of spaceflight and the new cosmonaut.[5] Mass public spectacles and events commemorated new technologies launched by the space age, and fit into the paradigm of the ideological and technological race with the West during the cold war era. These events, celebrations and rallies, therefore became sites for the Soviet masses to become involved in the public spectacle of display for "Soviet big science and technology."[6]

4 For an analysis of popular science and the cosmos, see James T. Andrews, "In Search of a Red Cosmos," in Stephen Dick and Roger Launius, eds, *The Societal Impact of Spaceflight Globally* (Washington, D.C., NASA/Smithsonian Publisher, 2007).

5 For an analysis of the cultural ramifications and material culture of space flight in the former Soviet Union, see forthcoming co-edited volume: James T. Andrews and Asif Siddiqi, *Into the Cosmos: Space Exploration and Soviet Culture* (Pittsburgh: University of Pittsburgh Press, Russian Studies Series, Forthcoming, 2011). For a look at the deification of certain heroes of the space age by the regime in creating a canonical pantheon to Soviet big science, see James T. Andrews, *Red Cosmos: K. E. Tsiolkovskii, Grandfather of Soviet Rocketry* (College Station: Texas A & M University Press, 2009).

6 See James T. Andrews, "Storming the Stratosphere: Space Exploration, Soviet Culture and the Arts 1917-1964," *Russian History/Histoire Russe*, 36 (2009), 77-88.

Appendix

Outline of a paper "Science, Communicative Discourse, and Popular Culture – A Soviet Scientific Public Sphere, 1917-1964"

I. Introduction: Science Popularization and the Tsarist Legacy Prior to 1917

II. The Russian Revolution, the Soviet State, and Public Scientific Discourse: The Twenties as Transitional Era, 1917-1928

III. The Stalinist Technical Revolution: From Pan-European Popular Science to Nationalistic Popular Soviet Technology, 1928-1953

IV. Big Science & Popular Technology in the Context of the Ensuing Cold War, 1953-1964

Science for the Masses: The political background of Polish and Soviet science popularization in the postwar period

Leszek Zasztowt

Institute for the History of Science, Polish Academy of Sciences, Warsaw

Between Real Socialism and democracy in the sciences.

"Painting is self-discovery. Every good painter paints what he is." (Jackson Pollock)

Science communication was probably one of the most forgotten and hidden elements to influence the process that resulted in an amazing solution to the whole Communist puzzle, and ultimately in the collapse of the system.

* * *

A characteristic feature of science popularization in the late post-industrial epoch of the 20th century was the dissemination of scientific information among large sectors of society (the so-called "masses" in Marxist-Leninist parlance).[1] However, this information was used on both sides of the Iron Curtain to serve different aims.

Western democracies in general advocate popularizing the latest scientific knowledge throughout society for its own educational value, although it often also has been used to create a media sensation. In the countries of the Eastern Bloc after World War II, especially in the USSR and in Poland—our main examples here—scientific information served as an essential element of political propaganda. The term "scientific consciousness," used quite frequently at the time, designated a materialistic point of view. Its decline had been announced in the West back in the 1950s, but it was still very much alive in the East.[2] Science in the Eastern Bloc had to show the superiority of the Real Socialist political system (Communism *in spe*) over capitalism as a whole. So science popularization was a main tool to demonstrate and prove this superiority, often using quite primitive, vulgarized methods.

1 James T. A n d r e w s, *Science for the Masses: the Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917-1934,* College Station, Texas 2003. The title of my essay consciously cites the title of J.T. Andrew's book. This catchphrase was the most popular advertisement for science dissemination of the period, both in Soviet Russia and in Poland after World War II.

2 Henryk S k o l i m o w s k i, *Zmierzch światopoglądu naukowego* (The Decline of Scientific Consciousness), London 1974; See the latest book with a contemporary view on that topic: Douglas M. S t o k e s, *The Conscious Mind and the Material World: on Psi, the Soul and the Self*, London 2007.

In the 1950s the situation in science communication to some extent resembled the state of affairs in modern art (Fig. 1). The West was already dominated by modern abstract painting, like Jackson Pollock compositions, while an unreconstructed Social Realism ruled in the East, based on the patterns deeply rooted in the 19th century. In both arts and sciences in the West, democracy and freedom of expression stood in contradiction to the political aims of old-style Communist superiority implemented in the East. The level of complexity in the sciences and their approach to the crucial scientific issues on both sides of the Iron Curtain were quite similar, but the methods of expressing this complexity to the people and the way it was presented to a broader audience differed transparently. In Socialist Realism the portrait of the scientist was a realistic depiction in the mode of a working class hero, i.e., the proletariat. He had to be recognizable, ideologically correct, and deeply convinced about the bright future of Communist science. There was no place for any abstract and non-depictive solutions, nor to search for any new forms of creating a dialogue with the reader or viewer. This was also true for the way general scientific questions were presented—everything had to be explained simply and straightforwardly, and based on the correct politics.[3]

One can acknowledge several stages of disseminating science through Eastern society. These stages coincided with the subsequent periods in the political history of the Eastern Bloc. For the countries of East Central Europe, the most tragic was the period directly after World War II, up to the year 1956 and the 20th Congress of the Communist Party of the Soviet Union (CPSU). The political thaw which started thereafter improved the situation in cultural and social life, and also embraced academia, science and its dissemination, but it ended very rapidly at the close of the 1950s. Neither Nikita Khrushchev nor Leonid Brezhnev wanted to make these changes permanent. Therefore their satellites, like Władysław Gomółka in Poland, reined in the fresh political breeze,[4] mindful of the Hungarian bloodbath committed by the Soviets in Budapest.[5]

The decadent period of Stalinism was characterized, on the one hand, by the ubiquitous influence of ideology on science and its popularization, which was widely and easily recognized in the obligatory quotations from classic texts by Marx, Lenin and Stalin opening and closing every book on science. On the other hand, the permanent bans on research and information concerning forbidden disciplines and restricted areas of study was a constant phenomenon. This affected cybernetics, some fields of biology, the chromosomal theory of heredity, behavioral psychology, and some limited areas of the fields of linguistics, history, philosophy and sociology. Many spheres of the humanities were particularly subjected to considerable censorship. Within the framework of the battle against cosmopolitanism that started in the USSR in the second half of the 1940s, most scientific relations with the West remained disrupted, and many of the spheres mentioned were officially condemned as "bourgeois" or "backward." This was a side effect of the Communist authorities' fear of the reaction by millions of Red

3 Jakub S a d o w s k i, *Między Pałacem Rad i Pałacem Kultury. Studium kultury totalitarnej (Between the Palace of Soviets and the Palace of Culture. A Study of Totalitarian Culture),* Kraków 2009.

4 Wiesław W ł a d y k a, *Na czołówce: prasa w październiku 1956 roku* (On the Front Page: Newspapers in October 1956), Warszawa 1989

5 *1956 - The Hungarian Revolution and War for Independence,* ed. by Lee Congdon, Bela K. Kiraly and Karoly Nagy, Boulder 2006; see also: *1956 – Budapeszt: Wegrzy, Polacy: twarze i losy* (1956 – Budapest: Hungarian, Poles: Faces and Fates), ed. by Örs Csete, Warszawa 2000.

Army soldiers returning to their home country after having seen the West—and its incomparably higher standard of living in Europe as compared with the USSR. The battle against cosmopolitanism, conducted by Leningrad's First Secretary Andrei Zhdanov, soon became known among the people as "Zhdanovschina." His official addresses were received as the benchmark for all scientific and artistic circles, blessed by his insignia of authority. Zhdanov indicated what was right and wrong in scientific theories and practice, as they were reconciled with Marxism-Leninism-Stalinism.[6]

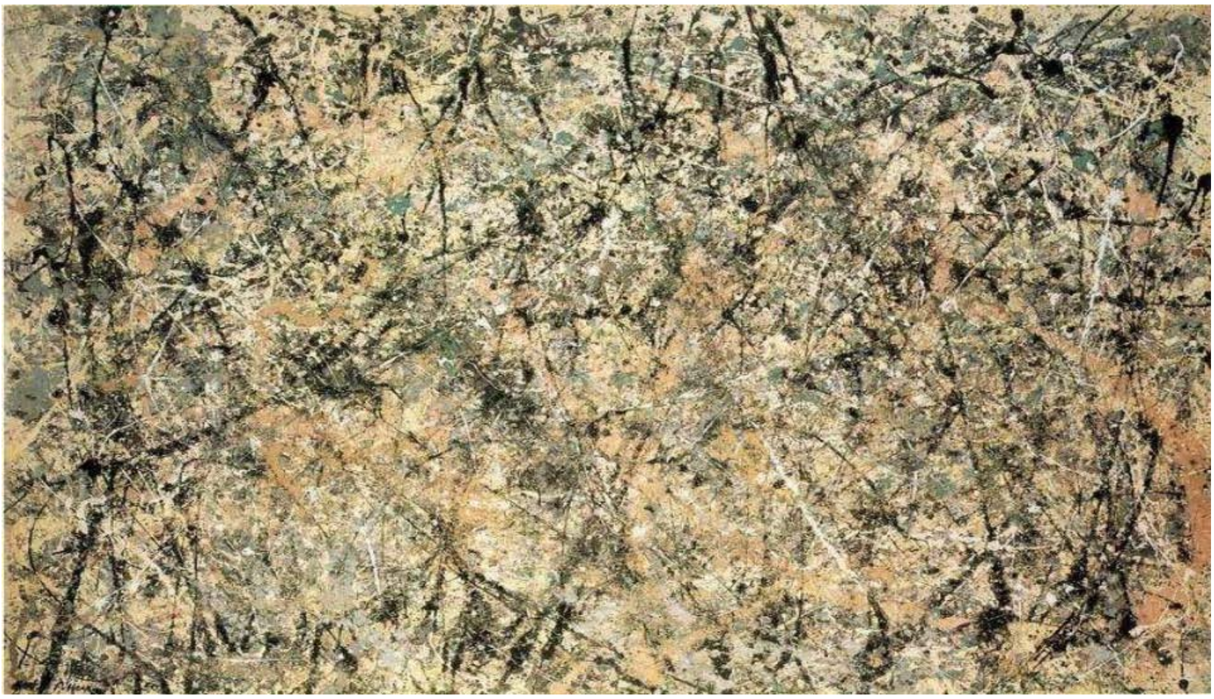

Fig. 1: Jackson Pollock – Lavender Mist (1950)
(National Gallery of Art, Washington, DC.)

Simultaneously, obligatory propaganda about successful Soviet science flourished. Books and articles convinced about that success were published in incredibly large print runs of up to millions of copies. Most of them were straight translations from Russian into Polish, very often simplified and narrow. The conviction of Soviet superiority in the sciences was spreading, backed by officials. In the 1960s Leopold Infeld—one of Albert Einstein's collaborators, who decided to return to Poland after the war (seduced by the Communist authorities), and quickly became one of the godfathers of modern Polish physics—wrote in his memoirs: because of the isolation some of the Soviet scientists lost their sense of proportion in the evaluation of some phenomena: namely many scientific discoveries whose authors are renowned all around the world were attributed exclusively to Soviet scholars.[7]

Practically all disciplines which did not have their representatives in Soviet scholarly life were condemned as "idealistic."

6 Robert S e r v i c e, *A History of Twentieth-Century Russia,* Cambridge 1998, p. 318.

7 Leopold I n f e l d, *Szkice z przeszłości (Essays from the Past),* Warszawa 1966, p. 243. This was also linked with the Soviet attacks on Albert Einstein in the early 1950s. Einstein was condemned in the USSR for his so-called "idealistic views".

A final effect of this situation was, first of all, the step-by-step decline of the social and natural sciences. The former took place under the careful eye of Joseph Stalin himself, and the latter were overcome by the influence of Trofim Lysenko and his zealots. East Central Europe again was gradually sunk into the heavy atmosphere of a European periphery, which this part of the continent was familiar with after the long 19th-century period without statehood that ended with the collapse of the empires in the final stages of the World War I. Independent thought was limited, and links to civilization gradually shattered, especially the connections with the West. Poland, along with other East Central European countries, became a borderline territory under special Soviet supervision. This was a kind of "Detour from Periphery to the Periphery," but one even more deprived of any of those national and state virtues enjoyed at least to some extent before the Second World War.[8]

An administrative system of science popularization came into being, created on the model of the USSR. In Poland one central institution was founded,*Towarzystwo Wiedzy Powszechnej* (the Society of Universal Knowledge), in 1950. However, science issues were managed exclusively by the Central Committee of the Polish Communist Party (from 1948 on, known as the Polish United Workers Party). At the top of the scholarly and scientific ladder, the Polish Academy of Sciences was established in 1952, based on the Russian and Soviet model,[9] not only to focus on scientific research, but also to serve as the highest state office for all university and advanced academic studies. A certain part of its activity concerned the diffusion of science in society. However, the essential part, performed first and foremost, was the overwhelming censorship, which often even determined the direction and character of books in print, press articles and broadcasts. After 1956 these limitations diminished, both in Poland and, to a lesser degree, in the USSR, but they never ceased to exist.

There is no doubt that Poland was still one of the most broad-minded states in the camp at the close of the 1950s, continuing to grow even more liberal, while the less restrictive relations with the West provided for considerable improvement in the situation.[10] No scholars were dismissed from their positions (or at least only very few), forced to seek work as caretakers, doormen, stokers or bus and tram drivers (as was common in the GDR, Czechoslovakia, Romania, Bulgaria, and Hungary). Those professors who were not allowed to work with students continued to perform research at the Polish Academy of Sciences. After 1956 they were even allowed to publish books and articles. Those who faced no objections from the authorities could even travel abroad. The atmosphere in the universities improved as well. Some scholars were allowed to return to university lectures and activities. Some non-governmental channels gave them opportunities to publish in semi-independent newspapers and journals, mostly of them associated with the Catholic church. From this point on, Poland was unique in the Eastern Bloc.

Yet there were still many areas which remained under the overpowering influence of ideology (especially the political sciences and economy). In the 1960s and 1970s the diffusion of sci-

8 Ivan T. B e r e n d, *Central and Eastern Europe, 1944-1993: Detour from Periphery to the Periphery,* Cambridge 1998.

9 Alexander V u c i n i c h, *The Soviet Academy of Sciences,* Stanford 1956; Zhores A. M e d v e d e v, *Soviet Science,* New York 1978.

10 John C o n n e l l y, *Captive University. East German, Czech, and Polish Higher Education, 1945-1956,* Chapel Hill-London 2000.

ence in Poland gradually became depoliticized. Among other things, mass editions of Western scientific literature appeared. Polish translations of these books and journals even became available in the USSR.

In the midst of the 1960s, however, this complex situation was symptomatic of the Communist party approach to intellectuals. On one hand the Central Committee declared that it had no intention of involving the party in specific jobs or the workshops of men of letters, but on the other hand, Socialist Realism was declared the preferred mode of expression. In March 1964, 33 intellectuals prepared a letter to the prime minister, in which they protested against the "limits in rationing paper" (its allocation was limited by the state), as well as against the "sharpening censorship in the press." In reaction, the authorities began a campaign criticizing those who signed this protest letter.[11] The main argument advanced by the rulers was that no book or press article should be allowed to contradict the ideas of socialism.

The main question remains: why was Poland allowed to enjoy greater freedom than other Soviet satellite states? Why was Polish science not treated as restrictively as in the neighboring states? In my opinion we have at least two answers to these questions. On the one hand, Poland was treated as a kind of an experimental area in the Soviet Bloc, and this special status was consciously accepted by the Soviets. On the other, the internal policy of Polish Communist authorities was less ideologically narrow, and a bit more independent from Big-Brother-style supervision, at least as far as the limited liberties in the country were concerned. It is possible that both answers are equally positive to a certain degree.

European milieu, Polish and Russian traditions. The legacy of the 19th century

Despite the fact that the Soviet influence on Poland persisted, a distinct and recognizable Polish tradition still survived, which was based on its 18th and 19th-century heritage. Both Poland and the Soviet Union, treated as a continuum of tsarist Russia, had their own established traditions of communicating science. In the USSR there were a great number of journals, book series, open lectures and the like established before the revolution of 1917, many of which continued in some form, although often they had been forced to change direction and condemn their legacy.[12] This legacy was, of course, typically European—a tradition similar to those of the French, German and English.

Similarly, the tradition in Poland had its roots in the Age of Enlightenment and had flourished since the Positivist epoch of the 1860s. The journals and book series published in the second half of the 19th century extended this tradition up to the Second World War, and sometimes even to the end of the 1940s.[13] Journals such as *Ateneum* ("Athenaeum"), *Gazeta Świąteczna* ("The Holiday Gazette"), *Głos* ("The Voice"), *Światowid* (the Slavic pagan god with four

11 Andrzej P a c z k o w s k i, *Pół wieku dziejów Polski 1939-1989 (Half a Century of the History of Poland),* Warszawa 1995, p. 374.

12 Eleonora A. L a z a r e v i c h, *S vekom naravne. Popularizatsia nauki v Rossii. Kniga. Gazeta. Zhurnal (On the Edge of a Century. Science Popularization in Russia. Book. Newspaper. Journal)* , Moskva 1984.

13 Leszek Z a s z t o w t, *Popularyzacja nauki w Królestwie Polskiem 1864-1905 (Science Popularization in the Kingdom of Poland 1864-1905),* Wrocław 1989; i d e m, *Popularyzacja nauki w Polsce w latach 1918-1951 (Science Popularization in Poland 1918-1951),* [in:] *Historia nauki polskiej (History of Polish Science),* vol. V; *1918-1951,* part I, pp. 604-673.

faces), *Tygodnik Ilustrowany* ("Illustrated Weekly"), *Wędrowiec* ("The Rambler"), *Zorza* ("Dawn") were established before 1914, and continued their activity until the end of the interwar period; some of them began publishing revised editions after 1945.[14]

The legacy of the 19th century and the interwar period was very strong in Poland. When we compare the popular scientific journals from before the war with the press published in the late 1940s, many similarities are apparent. Even some of the same articles from previous versions appear, written by the same authors, which had been published for the first time in the 1920s or 1930s. The impression is that the first years of Polish everyday life after the war were a mere continuation of a previous period. Yet it must be emphasized once more that all of this changed with the so-called "ideological offensive" in 1948. Clearly, enforcing new models to eliminate this historical tradition was not an easy task.

Homo Sovieticus: How to cope with new reality

In spite of the tremendous efforts of the new Communist authorities of Poland it was not easy to create a new *homo sovieticus*[15] in this traditional society. To a certain extent, the circles of scholars and academicians were quite independent of the new rulers' influence. There were three particular reasons for this: the universities still enjoyed a high degree of academic freedom. There was even a Catholic University in Lublin, subordinated to the Church hierarchy. Even in the newly created Polish Academy, the authorities had to accept nearly all professors —including those who were forbidden to teach and had to be sequestered to prevent any contact with and influence on teenagers and students, as already mentioned above. In this period Poland was entirely different from the USSR, where ceremonies to commemorate Generalissimus Joseph Stalin as the Leader of the People of the World were a constant feature, as in the painting "The Anthem of People's Love" (Fig. 2). In Poland this kind of event took place at the end of 1940s. The cult of world leader was reserved exclusively for Stalin, but a small, mini-cult of personality was created to elevate comrade Bolesław Bierut, the president and first secretary of the Polish party.

Simultaneously the authorities began systematically to create a new social consciousness "based on science" (meaning Marxism). They focused their efforts on the ranks of individuals from Polish intelligentsia who were laic and secular in their views (and this applied to a significant percentage of pre-war Polish intellectuals). A specific feature of this flirtation of the intelligentsia with Communist authorities is depicted superbly by Czeslaw Milosz in his novel *Captive Mind*.[16] John Connelly's idea of the "captive university" was to some extent a reflection of a broader phenomenon of the "captive mind." Explaining this issue in detail would extend beyond the scope of this article. But there is a significant book written by one of those who were seduced by the new rulers at this early stage, entitled *The Trammeled Science — The Intellectual Opposition in Poland 1945-1970*. The final moment of illumination for the circles of left intellectuals in Poland was first the collapse of the 1956 thaw, and subsequently the officially inspired anti-Semitic campaign of March 1968. That was the moment that saw a

14 Andrzej P a c z k o w s k i, *Prasa polska w latach 1918-1939 (Polish Press in 1918-1939),* Warszawa 1980.
15 Mikhail G e l l e r, *Cogs in the Soviet Wheel: the Formation of Soviet Man,* London 1988.
16 Czeslaw M i l o s z, *Captive Mind,* New York 1990.

stampede to convert from the official ideology to its contestation for many, including outstanding scholars, writers, philosophers and academicians.[17] However, in the 1940s and 1950s the Communist state enjoyed some kind of hypnotic power over many. The new government could offer not only participation in progressive and revolutionary enterprises and activities, but also could take exclusive care of prominent authors and scholars.

Fig. 2: "Anthem of People's Love" (1950-51) created by a brigade of young Ukrainian painters (Platon Biletsky and Igor Reznik) under the guidance of People's Artist of USSR, Academician of the Academy of Art of the USSR, Professor Oleksi Shovkunenko.

(Source: Jurii Maniichuk Collection, Washington, D.C., U.S.A., http://www.maniichuk.com)

Furthermore, the circulation of books grew enormously, as did the number of titles. So the chances for intellectuals to spread their wings were very seducing. Over half of the books produced in Poland between 1944 and 1951 were connected with science and its popularization.[18] But most of them were devoted to the exact and natural sciences, while only small numbers covered the humanities[19] (aside from the mass editions on politics, of course). One must remember, however, that statistics in Poland were constantly falsified from 1948 on. The most prestigious publishing houses, or, more precisely, those officially supported by the state, were *Czytelnik* ("The Reader"), *Wiedza Powszechna* ("Universal Knowledge"), *Państwowe Zakłady Wydawnictw Szkolnych* ("The State Institute for Educational Editions"), the cooperatives *Książka* ("Book," a branch of the Communist Party) and *Wiedza* ("Knowledge," a branch

17 Ryszard H e r c z y ń s k i, *Spetana nauka. Opozycja intelektualna w Polsce 1845-1970 (The Trammeled Science – Intellectual Opposition in Poland 1945-1970),* Warszawa 2008.

18 Leszek Z a s z t o w t, *Popularyzacja nauki w Polsce w latach 1918-1951 (Science Popularization in Poland 1918-1951)*, p. 648.

19 Adam B r o m b e r g, *Książki i wydawcy. Ruch wydawniczy w Polsce Ludowej w latach 1944-1957 (Books and Publishers. Publishing Movement in the People's Republic of Poland in 1944-1957),* Warszawa 1958.

of the Socialist Party). Later both cooperatives were merged into one state-owned publishing house *Książka i Wiedza* ("Book and Knowledge").

Some of the private firms also managed to survive until 1947, like Gebethner and Wolff, Książnica-Atlas, Trzaska, Evert and Michalski, and Stanisław Arct Ltd. After 1948 all publishing production was subordinated to the state and none of the private enterprises survived.

As concerns journals and newspapers, in 1945 there were 376 titles, but in the following years 723 (1946), 777 (1947), and even 880 in 1948. The collapse occurred in 1949, but we do not have any numbers on this development, because the state statistics were classified. But in 1953, when the government decided to resume the publishing the data, there were only 376 titles—exactly the same number as at the end of the war.

The most popular new titles were weeklies (sometimes monthlies): *Odrodzenie* ("Renaissance"), *Kuźnica* ("Ironworks"), *Nowiny Literackie* ("Literary News"), *Wiedza i Życie* ("Knowledge and Life"), *Problemy* ("Problems"), *Nauka i Sztuka* ("Science and Art"), *Życie Nauki* ("The Life of Science"), *Książka i Kultura* ("Book and Culture"). All of these journals stressed the value of science dissemination, and except for two Catholic journals, one of them Cracow's *Tygodnik Powszechny* ("Universal Weekly"), all advertised and propagated the materialistic point of view.[20] However, at the same time it must be acknowledged that the articles and texts often were written by the best scholars and professors at the time, as well as by the most prominent academicians. The quality of those articles was generally quite high, and as a rule the name of author was a guarantee for the content. Only a few journalists decided to fulfill the authorities' expectations in the field of sciences. It became clear to the government that its offensive in the sciences, and the battle with pre-war professors, must be inspired and based on the young generation of scholars. Such a campaign finally took place at the beginning of the 1950s, but the results of the battle were very limited.

Polish politically controlled liberalism vs. Russian hardliners in science

In the USSR Khrushchev's thaw ended in 1957, followed a year later in Poland. People were no longer interested in reading more writings by the Great Leader of the Revolution, despite the group scene depicted in the Alfred Lenica painting (Fig. 3). But the situation in Poland still looked more unconstrained and liberal than in its big brother's country. Poland began to play a rather unique role in the Eastern Bloc. In particular, there was first of all no collectivization on a mass scale, and toleration of limited private ownership and small enterprises. There was, second, a quite independent Catholic church that was very popular among the people. And, third, the intellectual atmosphere in Poland, too, was still incomparably freer than in the USSR, the Czechoslovak Republic or the GDR.[21] Gomółka attempted to bear-hug the country in his muscular political clutches, but the effects of his efforts were quite limited.

One thing should be explained here. In Poland in the 1960s, Marxism found itself in a zone that was only partly controlled by the party. Most prominent professors were allowed to

20 Even in *Tygodnik Powszechny* the Marxist approach to sciences was discussed in detail, mostly by Reverend Jan Piwowarczyk. See: Jan P i w o w a r c z y k, *Wobec nowego czasu: (z publicystyki 1945-1950), (Approaching New Times: Journalism 1945-1950),* Kraków 1985.

21 John C o n n e l l y, *Captive University,* op. cit.

develop their own materialistic philosophy quite freely, without any oppression or repercussions. Thanks to this efficient stimulus, Polish Marxism found a very positive reception in the West. Of course there were certain significant influences, above all from the French circles, mostly the *Annales* school (represented by Marc Bloch, Jacque Le Goff and others). This impact was evident. One of the famous Polish thinkers and historians of the period was Witold Kula; the other soon became the philosopher Leszek Kołakowski. All of this had an important impact on the communication of science in Poland. Between 1956 and the end of the 1950s there was no vulgar or primitive science propaganda, or at least it occurred on a very limited scale.[22]

On the other side of the border, in the USSR everything had long since returned to the previous, semi-Stalinist mainstream. Khrushchev preferred Socialist Realism in the arts and a traditional Marxism-Leninism in the social sciences.

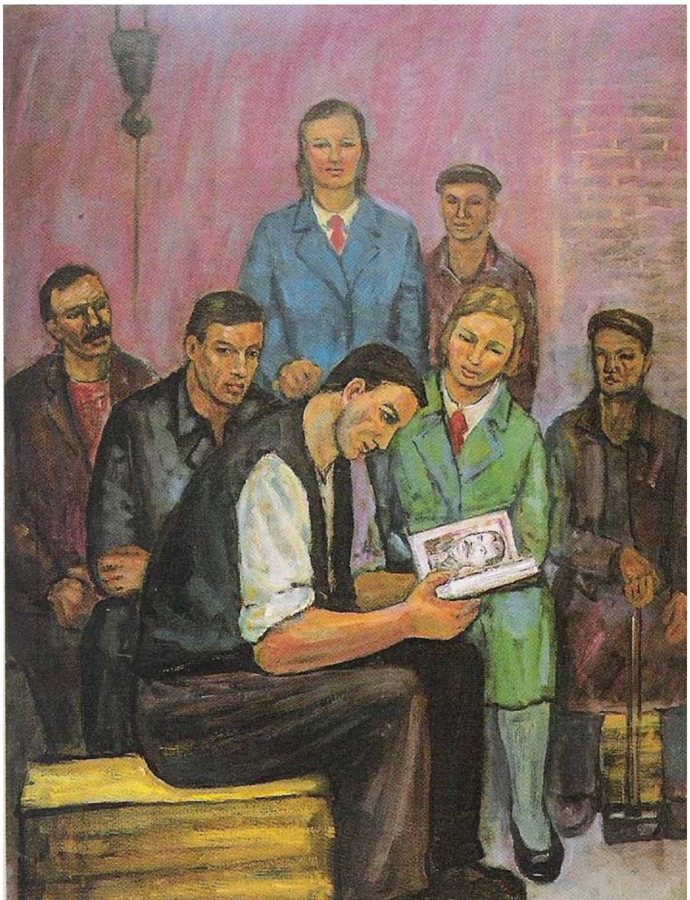

Fig. 3: Alfred Lenica: Learning Group (Kolo samoksztalceniowe), 1950,
Muzeum Zamoyskich, Kozlówka, Poland
(Source: http://artyzm.com/obraz.php?id=5499)

However, from the point of view of the exact and applied sciences, in particular, during this period the USSR ascended to the peak of its technical possibilities. At the time popular opin-

22 Andrzej P a c z k o w s k i, *Pół wieku dziejów Polski 1939-1989 (Half a Century of History of Poland 1939-1989),* Warszawa 1995, p. 326.

ion largely agreed that the Soviet country had already overtaken the United States, especially in the field of space exploration (Yuri Gagarin became the first human being in space by orbiting the Earth in 1961).[23] The space flight successes were becoming a Russian *spécialité de la maison*, and soon were reflected in the growing popularity of science fiction literature.

This literature became one of the most popular forms of science popularization in both East and West, inspiring the minds of people around the world. It should be added that Stanisław Lem, a Pole, was already acknowledged as one of its pioneers on both sides of the Iron Curtain. His novels like *The Astronauts* (1951), *The Magellanic Cloud* (1955), and later *The Star Diaries* (1957) and *The Invasion from Aldebaran* (1959) were subsequently translated into many foreign languages.

Polish sentiments about the West under Soviet supervision

The shadow of Stalin slowly disappeared, but the political system he created changed only in part, stripped of most of its former cruelties, cleansings and repressions. It was a specific conglomerate of the former Socialist Realism mixed with abstract painting, as in the Vagrich Bakhchanian painting *Picasso and the USSR*, depicting Stalin and an unknown pipe smoker (except that the pipes both have a similar moustache, Fig. 4).

Fig. 4: Vagrich Bakhchanian – Picasso and the USSR

(Source: Vagrich Bakhchanian: Portrait of Stalin on the one hundredth anniversary of his birth, Moscow, New York 1979, p. 12)

23 Robert S e r v i c e, *A History of Twentieth-Century Russia,* Cambridge 1998, p. 351.

But the wave of liberty and freedom from the West washed down a path strewn with formidable obstacles. In the 1960s everything in the Eastern Bloc was gray: the houses, the shops and streets, the politics, the universities, the people and first of all their clothes. But step by step, and little by little, the gate to broader thinking started to open. Soon the situation in Poland looked quite ambivalent. On the one hand there was a state-controlled monopoly on science and its diffusion. On the other, through limited contacts with the West, including left-wing newspapers, which were allowed to be sold officially, and also through radio, the space of intellectual freedom grew larger. Censorship boards allowed more and more significant *opera magna* to be translated and published in philosophy, sociology, linguistics and history. Those areas of the humanities started to improve and gradually return to their previous eminent positions. Scholars began to travel abroad. The results soon became apparent. Soviet citizens, *en masse* deprived of such possibilities, but with access to Polish books and journals in the USSR, became acquainted with Western scientific and cultural novelties through the Polish language. It was probably the one and only moment in Polish-Russian, and Polish-Soviet relations, when Soviet citizens studied and learned Polish on a such significant scale.

Political opposition and its views on science: Science communication and mass education – an unexpected result of social changes

At the beginning of the 1970s, Poland, under its freshly elected first secretary Edward Gierek, opened the door to the West. Poles could travel abroad, and not just party officials or renowned athletes and artists. Many young people brought from the West not only hard-earned valuta, but also books and information. Since the mid-1960s there had been a growing political opposition in the country. After March 1968, when the exodus of Polish intellectuals of Jewish extraction was triggered by a state-controlled and state-inspired anti-Semitic campaign, the opposition was closely linked with the university milieu.[24]

The university circles began their underground activity. In 1977 the so-called "Flying University" and the Society of Scientific Courses (Lectures) were founded.[25] Both were connected with the Committee for the Defense of Workers (KOR), and started a broad program of open lectures, unfettered by any censorship, aimed at the younger generation. Simultaneously emerged the quasi mass production of *Samizdat* (from the Russian: *samodeiatiel'noie izdatiel'stvo*: an independent edition). Those books which had not made it past the censors were published outside the official and state system.

The effect of these actions was overwhelming. On the one hand, the practice of official censorship diminished; on the other, books printed outside state control became increasingly popular. The titles of this *Samizdat* stream include nearly all of the most important books on science whose publication had been banned for political reasons.

What changed on the popular science market? First of all, voices were heard that represented a point of view totally at odds with the official line on many crucial scientific questions. The

24 Jerzy E i s l e r, *Marzec 1968: geneza, przebieg, konsekwencje (March 1968: Genesis, Processes, Consequences),* Warszawa 1991; i d e m, *Polski rok 1968 (The Polish Year 1968),* Warszawa 2006.

25 Ryszard T e r l e c k i, *Uniwersytet Latający i Towarzystwo Kursów Naukowych 1977-1981 (The Flying University and Society of Scientific Courses 1977-1981),* Kraków 2000.

main areas and directions where *Samizdat* activity was the most vigorous were the humanities and social sciences, like history, sociology, anthropology, political sciences, psychology, and linguistics, but also philology. The barriers built around the exact sciences, technology, medicine and natural sciences had disappeared earlier, back in the 1960s.

What was known as "Real Socialism" brought tremendous social advancement for many sectors of the population in Poland and in the USSR, for those people who previously had very limited or narrow prospects of a university education and little chance to change their social status significantly.[26] The regime tried to create its own, new elite, and its own social and political basis supported by the lower strata of society.

The unexpected result of those social changes in Poland was that the newly educated people identified themselves not with the Communist authorities, but with the anti-Communist opposition, in effect with the old and traditional values of Polish culture. At the beginning of the 1980s Solidarity proved that there were over 10 million such people—human beings who chose freedom, even over the comfort of economic stability. Science communication was probably one of the most forgotten and hidden elements to influence this process that resulted in an amazing solution to the whole Communist puzzle, and ultimately in the collapse of the system.

The processes which fostered "scientific" changes in the minds of the population of East Central Europe after 1945, and Poland itself, were very significant. In a simplified way those tendencies might be defined as an urge to establish social relations based on truth not only in sciences and scholarly life, but also in everyday life and politics—to put an end to Communist double-think. This began in Poland in 1980, concluding there in 1989. The USSR ceased to exist in December 1991. After years of indoctrination, the former Soviet citizens were in a much more complicated situation than Poles. On the one hand, the level of education embracing the exact and natural sciences in post-Soviet society was high. On the other, the ability to discard the former propaganda and to speak and think freely was limited because of the traditional fear of the authorities' reaction. Even Gorbachev's *glasnost* opened the gates to unrestrained thinking only very narrowly. Soon the Russian Federation became the successor to the USSR, and began the process of regaining its imperial position. Therefore after the collapse of the USSR it is much more difficult to forecast the state of affairs in the Russian Federation, and in many of the former Soviet republics. The situation in science popularization in these countries differs, as does the state of their scientific institutions. The social role of scholars, although they enjoy a high social esteem, is rarely decisive. They do not often have much opportunity to influence political practice. The old stereotypes concerning the neighboring countries and the West as a traditional enemy arise frequently. Does science provide any opportunity to overcome those national resentments and phobias, and is it possible to keep politicians from playing the national card in everyday political practice, especially when they are endeavoring to regain their country's imperial position? Is the role of science in our 21st

26 Gerard L a b u d a, *Nauka, nauczanie, upowszechnianie nauki (Science, Teaching, Dissemination of Science),* Warszawa 1998; *Upowszechnianie nauki w świecie: nowe doświadczenie i badania (Dissemination of Science in the World: New Experiences and Researches),* collective work, Polish Academy of Sciences, Wrocław 1990.

century the solution, or is it a utopia? Transposing the words of Jackson Pollock,[27] is it true that every good scientist (as every good painter) studies what he is? And is research, like painting, a process of self-discovery? These questions are important both in the sciences and in everyday life. Even in the social sciences, predicting the future of the former Eastern Bloc, and especially that of the former Soviet republics, is still a serious question mark. Nevertheless, in the age of science politics, the role of decent science popularization seems even more important and crucial.

Some remarks on the future – Split of traditions?

The impact of politics on science communication seems very limited today. But if we look carefully at the social sciences, especially at history, political science and sociology, we might realize that the information is used—not so coincidentally—as a political tool for creating common opinions and sentiments. While the situation in Poland, and in those Central European countries which entered the European Union, looks more or less similar to the state of affairs in the old EU members, in the East, history especially is used more and more by the authorities to create a specific view of Europe and the United States. The post-Soviet conviction about the negative role of the West is still alive. It seems that we are experiencing a revival of the former situation: the split of approaches and the split of traditions which are used to understand the surrounding world in a non-positive way. Science seems once again to be instrumentalized in order to create a certain view for the masses. Alas, Poland and Russia are good examples of this situation.

27 Barbara N o v a k, *Voyages of the Self: Pairs, Parallels, and Patterns in American Art and Literature,* Oxford 2007, p. 147.

Public policies of publicisation of science in post-war France. Toward a “state affair” *

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Abstract:

The talk focuses on the second half of the 20th century and discusses the public policies concerning "publicisation" of science in France.

Publicisation of science in France developed largely during the 1980’s under the appellation “culture scientifique et technique” (scientifical and technical culture) in connection with an important redefinition of French science policy. This well-known episode is often considered as a starting point of strong public involvement in this domain. I will here show how, in the contrary, public concerns in publicisation of science emerge early in post-war France connected to different domains of public policies and then evolved toward what could be considered as some kind of a “state affair”. In looking at this issue I will develop some points of view partly complementary to the analysis that concentrate on the political impact on science communication.

Related Publication

Andrée Bergeron: Représentations, cultures, imaginaires, médias, engagements,
in: Dominique Pestre (dir.): Sciences technologies savoirs en sociétés. Questions actuelles, approches historiques, MURS - Numéro 57/58, 2008, p. 93-106

online: http://documents.irevues.inist.fr/handle/2042/24626

* The paper read at the Budapest Symposium is currently under revision and therefore could not be included in this preprint.

Atapuerca – the Making of a Magic Mountain. Popular Science Books and Human-Origins-Research in Contemporary Spain*

Oliver Hochadel

Universitat Autònoma de Barcelona

A unique place in the world

Popular science books are not only popular science books. They do more than just "hand down" a simplified version of scientific knowledge to a lay audience. They synthesize, reorganize and present knowledge to a variety of audiences including the disciplinary community of the authors themselves. Popular science books in human-origins-research are a particularly instructive example. They prove to be a most valuable source for historians of science because they show how the paleoanthropologists perceive themselves and their work. These books are far less "filtered" than their academic publications by professional constraints. The narratives of "where we come from" and what certain discoveries "mean", are much more explicit.

The following three quotes are from Spanish popular science books dealing with human-origins-research: According to the Spanish paleoanthropologist Juan Luis Arsuaga the

> "Sierra de Atapuerca is a unique place in the world. Like no other place it documents the changes in climate and in the ecosystems, in technology, and in the human beings themselves and their behavior in the course of an extremely long period of time ... These exceptional Paleolithic and archeological collection makes this into on of the best ensemble of sites in the world, the most historic place in Europe and the rocky heart of Spain, into a magic mountain."[1]

His colleague José Maria Bermúdez de Castro points out that until very recently the "important things" in human origins-research have been nearly always achieved in the UK, France and the USA. With the naming of a new species, that is *Homo antecessor* in 1997 by a Spanish team, this has changed. And Spanish archeologist Eudald Carbonell writes:

> "Atapuerca has become the excavation site with the greatest impact worldwide due to the quantity of the remains found and the uniqueness of many of these remains."[2]

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* This article is part of a larger research project on the interplay between science and the public in human-origins-research. So far it was funded by a mobility grant of the Spanish Ministry for Education and Science SB2006-0089.– The main popular science books treated in this paper are listed in the appendix; in the notes they are quoted by author or key word and year. All translations from Spanish and Catalan are my own.

1 Arsuaga 1999, 205.

2 History 2003, 137.

Nature, one of the leading scientific journals, wholeheartedly agrees:

> "La Sierra de Atapuerca is Europe's most important archaeological site for human prehistory, with almost a million years of life represented in the various remains found there."[3]

Before we look closer at the mechanisms of "promoting" Atapuerca through recent popular science books we shall briefly look at the history of the site and the discoveries made there. At the end of the 19th century a railway line was built right through the small Sierra de Atapuerca near Burgos in Northern Spain. The works brought to light a number of collapsed caves that contained numerous fossils. Other caves were still intact and had always attracted the curious. In 1978 the continuous scientific excavation began under the direction of Emiliano Aguirre. Since 1991 the scientists quoted above, Juan Luis Arsuaga, José Maria Bermúdez de Castro and Eudald Carbonell, act as co-directors of the Atapuerca research project. The 1990s were marked by spectacular fossil finds that propelled Atapuerca into the national but also international limelight. The results were published in top-journals such as Science and Nature.

For a moment I will act as a spokesperson of Atapuerca in order to convey the kind of rhetoric the researchers but also the Spanish media use when they report about the significance of the site. The bullet points are:

- In the Sima de los Huesos over 5000 (!) fossils of *Homo heidelbergensis* were found that make up for 80 to 90 percent of the hominid fossil register of the Middle Pleistocene (780.000-126.000 years ago) worldwide.[4] This can be converted into more than half of all the hominid fossils worldwide for the period up to 30.000 years ago.
- In 1994 the oldest hominid fossils in Europe were unearthed in the strata TD6 of the Gran Dolina (at least 780.000 years old).
- In 2007 a mandible was found in the nearby Sima del Elefante that pushed this "record" back to at least 1,2 million years. These fossils belong to *Homo antecessor*, the common ancestor of both *Homo sapiens* and Neanderthal, assuming a most prominent branching point in the human genealogical tree.[5]
- No other prehistoric site in the world contains fossils of three different hominid species (*antecessor, heidelbergensis* and *sapiens*), spanning more than one million years of evolutionary history.
- Atapuerca is often been described (or shall we say marketed?) as an "encyclopedia" or "book" of human evolution.

And the icing on the cake:

- The Sima de los Huesos yielded the most complete skull and the most complete pelvis in the hominid fossil record. The accumulation of corpses in this cave was intentional and hence constitutes the first symbolic act in human history.[6] Some of the fossils of

3 "Them bones." *Nature* 397 (1999): 314.
4 Catalog 2004, 103.
5 Catalog 2003, 106.
6 Catalog 2003, 87, 90.

Homo antecessor show clear cutting marks by stone tools and therefore represent the first incidence of cannibalism.

A deluge of popular science books

The thesis of this paper is that the enormous success of the excavations cannot only be explained by the sheer quantity and quality of the finds. What is striking about Atapuerca is not only the wealth of the fossils but also the multifold attempts of the researchers themselves to popularize their work in numerous articles in newspapers and magazines, guided tours through the site, TV documentaries, exhibitions, internet-sites including blogs and – this will be my focus – popular science books. I will try to show how these books helped to create the "magical mountain" of Atapuerca, a site that in the meantime represents the (imaginary) beginning of Spanish history.

Since 1998 the three leaders of the Atapuerca team, Juan Luis Arsuaga, José Maria Bermúdez de Castro and Eudald Carbonell, have in sum written or coauthored more than twenty popular science books. In some Spanish bookshops Arsuaga and Carbonell have their own little shelf within the anthropology section. They started writing these books after the spectacular finds in the first half of the 1990s and the naming of a new species in 1997. In order to provide an overview I have listed these books separately in an appendix at the end of this article. I have given them bibliographic keys in order to cite them easily.

It is not only the mass of books but also the breadth of genres that is surprising. The researchers did not only write the typical books about how they found what kind of skull and what that means for "our" origins. Arsuaga used different kind of genres including a portrait of the site of Atapuerca narrated by fictitious characters (e.g. tourist guides), a novel from the Paleolithic and a children's book.[7] One book is written in the form of a dialogue between Bermúdez de Castro and Carbonell.[8] There are also a couple of exhibition catalogs. Not all of these popular science books deal exclusively with Atapuerca and some hardly mention the site at all. Arsuaga for example wrote one book about the role of food in the course of human evolution and one about Charles Darwin.[9] Carbonell wrote several rather philosophical or epistemological works about the need to "socialize" knowledge in order to complete the process of "humanization."[10]

It is also interesting to note that there are hardly any books about Atapuerca that are not written or at least co-authored by one of the three directors. There is one book that went through several updated editions that does not bear either of their names on their cover: *La Sierra de Atapuerca. Un viaje a nuestros orígenes* (The Sierra de Atapuerca. A journey to our origins). Yet the three authors Carlos Díez, Sergio Moral and Marta Navazo have been working at the Atapuerca site for many years. And Arsuaga, Carbonell and Bermúdez de Castro each (!) contributed a foreword to the book.[11]

7 Arsuaga 2004; Arsuaga 2005; Arsuaga 2008.
8 History 2004.
9 Arsuaga 2002; Arsuaga 2009.
10 Carbonell 2000; Carbonell 2003; Carbonell 2007; Carbonell 2008.
11 Díez 2005.

What is furthermore remarkable is that quite a few of these books deal in parts or even entirely with the history of the excavations. There have been books to celebrate 25 years of research in 2003 and then the 30 years anniversary.[12] It is quite common that paleoanthropologists write about the history of their discipline and their own part in the discoveries. Yet the extent of self-historicizing of the Atapuerca project is unprecedented in the field of human-origins-research. For the historian of science these accounts serve as most valuable source because he learns an immense amount about the inner workings of the research group, at least how the researchers themselves portray it.

It seems fair to say that Arsuaga, Bermúdez de Castro and Carbonell were able to shape and control the image of Atapuerca to a very large extent, considering that books only form one part of their multi-media effort in popularizing their research. They write many newspaper articles themselves, are interviewed by print media, radio-stations and television, give dozens of talks every year, post regularly on their blogs, help to curate the exhibitions and to produce the documentaries.

As far as I can see, the Spanish media have never criticized the research project of Atapuerca or portrayed in a bad light. For the leading Spanish daily *El País* Atapuerca is simply "the most important excavation site in Europe."[13] The criticism of foreign researchers with respect to the central position of *Homo antecessor* in the human pedigree is never mentioned in Spanish publications (see below).[14] In what follows I would like to discuss three hypotheses on the importance of popular science and to analyze in how far this applies to Atapuerca.

1. Medialization of Science

The popular science books written by the co-directors of the Atapuerca project are an indicator for the increasing "medialization of science", a term coined by Peter Weingart. By medialization Weingart means „the central role of the media for the communication with a society including the repercussions with all other parts of society". This central role of the media forces the scientists to directly address the public and to follow the „logic" of the media in order to promote their research, be it by writing popular accounts of their work or by contacting journalists. And with the necessity to secure funding for their increasingly expensive research this "outreach" has become more and more important, Weingart argues.[15]

Paleoanthropologists usually freely admit that their work would be impossible without the support of the media and the interest of the general public. The researchers in Atapuerca are particularly frank about this. They refer to journalists as "our friends."[16]

12 History 2002, fifth edition of Díez 2005.

13 Ordax, Aitor. "Un viaje a la prehistoria." *El País*, 2 July 2008.

14 I have sampled roughly 150 newspaper articles on Atapuerca that appeared between 1992 and 2009, mainly from *El País*.

15 Weingart, Peter. *Die Wissenschaft der Öffentlichkeit. Essays zum Verhältnis von Wissenschaft, Medien und Öffentlichkeit*. Weilerswist: Velbrück Wiss., 2005, quote 12.

16 History 2004, 341.

Fig. 1: Selection of cover pages of books on Atapuerca

Eudald Carbonell writes: “The impact of Atapuerca in science, in the media, in all areas of social life was a phenomenon that was created intentionally. The underlying strategy had the purpose to build a team that could do research into human evolution in acceptable conditions.”[17] Yet this impact was not created in order to foster the individual interests of the researchers but rather as a crucial step in the “socialization of knowledge,” Carbonell’s political project of social emancipation. Only with a broad support by the media the knowledge gained in Atapuerca can be spread through society and hence made more democratic.

The researchers are very much aware of the “logic” of the media and the “economy of attention.” Carbonell, for example, criticizes the “fetishism of discovery” that prevents the acquisition of (real) knowledge.[18] Carbonell and Bermúdez de Castro insist (as would probably every paleoanthropologists) that they are not fossil hunters, „an idea that we still have to extirpate from the mind of some professional journalists“.[19] And Arsuaga – after having mentioned some of the „bullet points“ of the Atapuerca site mentioned at the beginning – stresses that the importance of a discovery does not consist in the oldest fossil or richest site but in the new information these finds yield.[20] Yet because these data are usually far more complex, they are not in line with “logic” of the media. Arsuaga mentions for example “changes in climate and in the ecosystems.” Alicia Rivera, a science journalist from *El País*, who has written dozens of articles about Atapuerca, told me in an interview: “What makes headlines are news about the biggest, the oldest and so on.”[21] This is to some extent even true for scientific top-journals such as *Nature* and *Science* because their audience consists of scientists of all disciplines. In March 2008 the spectacularly old mandible from the Sima del Elefante was announced on the cover of *Nature* as the “first European.”[22]

This is the medialization of science in a nutshell: despite their criticism of the “logic” of the media scientists will have to resort to “bullet points” if they want to attract the attention of journalists and scientists alike.

2. Extended Battlefield

Carbonell and Bermúdez de Castro know: “The hypotheses and opinions about no matter what topic in human evolution are very different and are defended with true passion.”[23] There are at least two reasons for this. First, the field of human-origins-research is ideologically “charged” because it grapples with the question of what it means to be human. It is inevitably tied up with questions on the origins of language, consciousness and culture. And second, due to the severely limited number of hominid fossils, which are often fragmented and distorted and therefore very difficult to interpret, controversies are the norm.

I would claim that these popular science books serve as an “extended battlefield” to carry on the debates being fought in the scientific community in the public realm. A good example for popular science books being transformed into an ink-stained battlefield is the epic debate

17 Carbonell 2007, 106.
18 Carbonell 2007, 106.
19 History 2004, 113.
20 Catalog 2004, 103.
21 Interview with Alicia Rivera, Madrid, 21 July 2009.
22 Carbonell, Eudald et al. "The first hominin of Europe." *Nature* 452, no. 7186 (2008): 465-469.
23 History 2004, 314.

about whether modern man originated only in Africa – the so called Out-of-Africa theory – or rather in a large geographic space that includes Eurasia as well – the so called multi-regional-theory. It has been fought a lot in the popular media and in particular in popular science books in the 1980s and the 1990s. Chris Stringer is one of the protagonists of Out-of-Africa, Milford Wolpoff is he most vocal defender of the multi-regional-theory.[24]

Resorting to the public has been described by Massimiano Bucchi as “deviating” the normal process of discussing issues within the scientific community itself. Referring to the case of could fusion he writes: “just as happens for a certain form of political discourse, scientists’ discourse at the public level is only apparently ‘public’: Communications at this level is not actually meant to address the public, but to send ‘coded messages’ to colleagues without having to conform to the constraints of specialist communication.”[25]

To a varying degree this seems to be the case for numerous scientific disciplines. Yet there are important differences. Human-origins-research, for example, is already a well-established discipline so the debate focuses on certain issues. Yet popular science can also be used, and quite intentionally, to found and establish a new discipline and its agenda. One of the most recent examples is the case of Evolutionary Psychology.[26] A similar case can be made for the founding and early phase of ethology. Konrad Lorenz formulated his influential views on aggression in his popular science books in the 1950s and 1960s.[27]

3. Meta-narrative

It is very difficult to put forward, for example, a new theory about the Neanderthals in a peer-reviewed journal demanding brevity and original data. The popular science book does not have to meet these requirements. Therefore it serves as a meta-narrative allowing for a general overview, a synthesis of current research, the discussion of overarching questions and speculations on the course of human prehistory that would not be possible in peer-reviewed articles. The US-paleoanthropologist Ian Tattersall, a prolific writer of popular science books, told me in an interview: “I feel when I write a trade book I can make a lot of points that I can’t make in technical papers that get reviewed and reviewed to death. It gives you much more freedom to build up arguments about what one perceives and one believes than one has in the technical press.”[28]

Again, human-origins-research is only one of many examples of the uses of popular science by scientists: The public domain „can also be utilized as a creative space for scientists where they can operate outside of the usual constraints of academic discourse, speculating freely about their work and discussing controversial issues in ways that would not be published in

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24 For a more detailed account of how this controversy was fought out in popular science books see Hochadel, Oliver. "Die Knochenjäger. Paläoanthropologen als Sachbuchautoren." *Sachbuch und populäres Wissen im 20. Jahrhundert*, edited by Andy Hahnemann, and David Oels, 29-38. Frankfurt a.M. etc.: Peter Lang, 2008.

25 Bucchi, Massimiano. "When scientists turn to the public. Alternative routes in science communication." *Public Understanding of Science* 5 (1996): 375-394, 380.

26 Cassidy, Angela. "Evolutionary psychology as public science and boundary work." *Public Understanding of Science* 15, no. 2 (2006): 175-205.

27 Taschwer, Klaus, and Benedikt Föger. *Konrad Lorenz. Biographie*. Wien: Zsolnay, 2003, 59, 149f.

28 Interview with Ian Tattersall, Bonn, 23 July 2006.

academic journals without stronger supporting evidence."[29] The fact, that these popular science books often get reviewed by colleagues shows, that they are being read and discussed within the scientific community.[30]

Arsuaga's *Neanderthal's Necklace*

We shall now try and analyze one of the Atapuerca books within the theoretical framework sketched above. Economically speaking Arsuaga's books seem to be the most successful ones. Arsuaga's first popular science book *La especie elegida* (*The Chosen Species*) has so far gone through 24 editions and is also used as a textbook in Spanish universities.[31] This shows that the audiences of a popular science book can be very diverse. *La especie elegida* was translated into English, so was *Amalur* (*The Green Fire*).

Yet the most impact seems to have had his *El collar del neandertal* (*The Neanderthal's Necklace*), first published in 1999. It did not only go through numerous Spanish editions but was also translated into English, French Dutch, Catalan and German. This book is only in parts about the Neanderthal. It is a broad overview on human evolution with specific focus on the evolution of consciousness or the mind. The subtitle is *In Search of the First Thinkers*. The book synthesizes current research yet at the same time it also puts forward specific research hypotheses. Arsuaga argues that despite their "humanity" and their cognitive abilities Neanderthals did not use symbolic representations. Therefore they could not compete with *Homo sapiens* and finally went extinct. Arsuaga also takes issue with recent theories of Ian Tattersall and Steven Mithen about the origin of human language. In a way, the entire book is a running commentary on existing scholarship.

Not least owed to the fact of being translated into English *The Neanderthal's Necklace* was reviewed in several academic journals.[32] And the paleoanthropologist Bernard Wood mentioned in the review of another book on human evolution *The Neanderthal's Necklace* in *Nature* as further reading.[33]

Arsuaga got mixed reviews. With the exception of the psychologist Sherman all of the reviewers were professional scientists in the field of Human Origins Research. That may explain why Sherman wrote the most affirmative review. Bruno Maureille, an expert on Neanderthals,

29 Cassidy (n. 25), 179, referring to Felt, Ulrike. "Why should the public "understand" science? Some aspects of Public Understanding of Science from a historical perspective." In *Between understanding and trust: the public, science and technology*, edited by M. Dierkes and C. Grote, 7-38. Berkshire: Harwood Academic Publishers, 2000, 30.

30 In the case of books on evolutionary psychology this phenomenon seems to be very widespread: „Several of these books have relatively high citation rates in academic journals, going into the hundreds in some cases." Cassidy (n. 25), 179.

31 Díez 2005, 188.

32 Bisson, Michael S. "Review of: The Neanderthal's Necklace: In Search of the First Thinkers." *Journal of the Royal Anthropological Institute* 10 (2004); Clark, Geoffrey A., and Jessica C. Thompson. "Palaeoanthropology for Middlebrows: The Neanderthal's Necklace: In Search of the First Thinkers." *Cambridge Archaeological Journal* 14, no. 1 (2004): 141-144; Maureille, Bruno. "A vision of fossilized humankind: The Neanderthal's Necklace: In Search of the First Thinkers." *Endeavour* 28, no. 1 (2004): 4; Sherman, Julia A. "Thoughts from a psychologist: The Neanderthal's Necklace: In Search of the First Thinkers." *The Human Nature Review* 3 (2004): 216-218. *Endeavour* is a popular science magazine.

33 Wood, Bernard. "So near, but yet so far." *Nature* 420 (2002): 609.

focuses on some contentious issues in his own field of research. He concedes that even "a specialist can find numerous subjects that stimulate thought."[34] Clark and Thompson are very detailed in their review, handing out praise and criticism in equal measure. They take issue, for example, with the style and the (lack of) organization of the book. They are also well aware of the contentious claim of the Atapuerca researchers as regards the position of the *Homo antecessor* within the human ancestry, a topic we will deal with later in this paper.[35]

In *The Neanderthal's Necklace* Arsuaga not only aims at the general public but also at his scientific peers. In this "popular" science book many of the current debates in human-origins-research are addressed. His colleagues agree that this book contains new ideas that are worth discussing in a scientific journal. It is therefore sometimes very difficult if not impossible to distinguish neatly between „scientific" and „popular" texts. The case of the popular science books on Atapuerca seems to provide another example for James Secord's concept of "knowledge in transit" that stresses the "fluidity of knowledge" and questions the assumption that there are clear cut boundaries between science and the public.[36]

Narrating Atapuerca

It is obviously not easy to analyze a most heterogeneous corpus of 27 popular science books on Atapuerca. The topics and the genres are very different. In what follows I will try to identify three of the interconnected narratives the authors use to tell their "story."

1. Endurance and due reward

In many of the books the story of the excavations resorts to the narrative of endurance: per aspera ad astra. We are told that in its early years the researchers had to overcome many difficulties. The team had a hard time financing the excavations. Furthermore, working in the remote cave of the Sima de los Huesos hidden deep within the Sierra de Atapuerca proved extremely difficult and also dangerous. Once they nearly suffocated. Tons of sediments had to be hauled out in rucksacks by the researchers themselves through long and narrow passages. Only through sheer will power and unshakable belief in their project they kept going.[37] In particular the period of 1988-1991, labeled "the dark years," proved very difficult.[38] With the spectacular finds of the early 1990s they were rewarded for their endurance.[39]

As said before: writing the history of one's own research is a way to control it. Therefore we get a sanitized version of events in the popular science books about Atapuerca. Conflicts within the team (e.g. about the naming of a new species) are usually not mentioned. Instead the heroic team effort is stressed.[40]

34 Maureille (n. 32).
35 Clark and Thompson (n. 32), 141f.
36 Secord, James A. "Knowledge in Transit." *Isis* 95 (2004): 654-672.
37 History 2004, 105-118, 276; Catalog 2003, 84f; Catalog 2004, 66.
38 Catalog 1998, 91.
39 Catalog 2004, 66f, 74; History 2004, 109.
40 History 2003, 143-145; History 2004, 118.

2. Emancipation and national self-determination: Atapuerca as a beacon of Spanish Science

The history of Spanish prehistoric research has often been portrayed as being dominated by "foreign powers." The initial denial of the authenticity of the Altamira cave paintings by a French archeologist and the sale of the "Dama de Elche" to the Louvre museum in Paris more than a hundred years ago, are the prime examples for this alleged "scientific colonialism."[41] This feeling of inferiority still surfaces occasionally at the end of the 20th century.[42] Without resorting to chauvinism fighting off the threat of "foreign dominance" is a recurring theme in some of the accounts of the early history of the project. The researchers stress the importance of turning Atapuerca into a "Spanish" project, run by Spanish scientists and serving as a mean to professionalize Spanish human-origins-research.[43]

In his review of *The Neanderthal's Necklace,* Bruno Maureille duly noted that „Arsuaga also wants to showcase modern Spanish palaeoanthropology".[44] To have found and baptized *Homo antecessor* is a source not only of individual but also of national pride. The project of Atapuerca was a highly unlikely success for Spanish science, Carbonell and Bermúdez de Castro agree.[45] And Carbonell wrote in his blog on 29 May 2007 in order to commemorate the tenth anniversary of the *Homo antecessor* publication: "For the first time a Spanish team has named a human species."[46] This feeds back into the marketing of the books. On the back cover of some of his books Carbonell is hailed as the best-known Catalan scientist worldwide.[47]

The term of Atapuerca has become a trademark. Already on the cover of some of the books of Arsuaga and Bermúdez de Castro the authors are identified as co-directors of the Atapuerca project.[48] The presses obviously and correctly assume that the name recognition of the place is higher than the name recognition of the authors.

In recent years the researchers as well as the media refer to the Sierra de Atapuerca more and more frequently as a "magic mountain."[49] This catch phrase is also used in the touristic promotion of the site. The metaphor denotes the density of information that can be gleaned from

41 Moro Abadia, Oscar. "Art caves as symbolic spaces: the case of Altamira." In *Sites of memory between scientific research and collective representations*, edited by Jana Maríková-Kubková, Nathan Schlanger and Sonia Lévin, 69-78. Prague: Archeolosgicky ústav Akademie ved Ceske republiky, 2009; Ruiz, Arturo, Alberto Sánchez, and Juan P. Bellón. "The history of Iberian archaeology: one archaeology for two Spains." *Antiquity* 76, no. 291 (2002): 184–190, 185; Díaz-Andreu García, Margarita. *Historia de la arqueología en España. Estudios*. Madrid: Ediciones Clásicas, 2002, ch. 5.

42 Catalog 2004, 66; History 2004 57, 276; Bermúdez de Castro 2004002, 42.

43 History 2004, 172f.

44 Maureille (n. 32).

45 History 2004, 27; similar History 2003, 161.

46 Eudald Carbonell: Conferència coincidint amb el desè aniversari de la presentació a Science d'una nova espècie; http://blocs.tinet.cat/blog/el-bloc-deudald-carbonell/category/258/conferencies/2007/05/29/conferencia-coincidint-amb-el-des-aniversari-de-la-presentaci-a-science-d-una-nova-esp-cie (last accessed 26 October 2009).

47 Carbonell 2007. Eudald Carbonell and other members of the Atapuerca team are Catalan, they are based at the university of Tarragona. Carbonell usually publishes his books in Catalan before they are translated into Spanish. Further research will have to find out if Catalan media (e.g. *La Vanguardia*, *El Periódico*) cast the research at Atapuerca in a different frame.

48 E.g. in the paperback editions of Arsuaga 1998; Arsuaga 1999; Bermúdez de Castro 2002.

49 Arsuaga 1999, 205. Ordax, Aitor. "Un viaje a la prehistoria." *El País*, 2 July 2008 ("colina mágica", magic hill).

the old caves. Yet it is also a promise to the future that this "montaña mágica" still holds many secrets about our origins in store.[50]

3. Establishing Homo antecessor in the human pedigree

There is nothing unusual about attributing greatest importance to one's own finds. In fact, this is rather the norm in paleoanthropology.[51] Yet the researchers from Atapuarca attempt nothing less but to redraw the human pedigree in a crucial spot. They claim that *Homo antecesso*r was the last common ancestor of *Homo sapiens* and Neanderthals – and not as assumed by many *Homo heidelbergensis* and/or *Homo erectus*.[52]

This claim is puzzling and confusing to many outside the discipline because they assume that "common ancestor" refers to the actual fossils found in Atapuerca. Yet this is not what the researchers suggest. They put forward a twofold scenario. On the one hand *Homo antecesso*r migrated from Africa through Asia Minor through Europe as far as the Iberian peninsula more than a million years ago. In Europe *Homo antecesso*r developed into *Homo heidelbergensis* and finally into Neanderthal. On the other hand the line of *Homo antecesso*r that had "stayed" in Africa developed into *Homo sapiens* – in Africa. Yet the fossils of the African line of *Homo antecesso*r have not yet been found.[53]

There is no room here to delve into the intricate details about the debate on the actual place of *Homo antecessor.* Suffice it to say that criticism in particular of the "African scenario" has been widespread right after the naming of the species in 1997 and was put forward in commentaries, news features, peer-reviewed articles, textbooks, popular science books and newspaper articles.[54]

To avoid misunderstandings: The international scientific community certainly values the Atapuerca fossils very highly. They are mentioned in nearly all the recent textbooks and overviews. Yet to anthropologists from abroad *Homo antecessor* proves yet again that the human genealogy is much better understood as a broad bush than as a slim tree. For them, *Homo antecessor* is one of the many extinct sidelines and the "African scenario" is considered highly speculative.

Yet as far as I could ascertain all this criticism was published outside Spain and nearly exclusively in English. It never surfaced in the Spanish media. Spanish science journalist Alicia

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50 Catalog 2003; 85, History 2004, 344-347.

51 Lewin, Roger. *Bones of contention: Controversies in the search for human origins*. 2nd ed. Chicago: The University of Chicago Press, 1997.

52 Arsuaga 1998, 304.

53 Arsuaga 1998, 304; History 2003, 152; History 2004, 329-331.

54 Commentaries: Delson, E. "Palaeoanthropology - One skull does not a species make." *Nature* 389, no. 6650 (1997): 445-446; news features: Gibbons, Ann. "A New Face for Human Ancestors." *Science* 1997, 1331-1333, 1331 (refering to criticism by French paleoanthropologist Jean-Jacques Hublin); peer-reviewed articles, Rightmire, G. Philip. "Human evolution in the middle Pleistocene: The role of Homo heidelbergensis." *Evolutionary Anthropology* 6, no. 6 (1998): 218-227, p. 224f. Tattersall, Ian. "Paleoanthropology: The last half-century." *Evolutionary Anthropology* 9, no. 1 (2000): 2-16; textbooks: Wolpoff, Milford H. *Paleoanthropology.* Boston, Mass. [u.a.]: McGraw-Hill, 1999, 471; popular science books: Tattersall, Ian, and Jeffrey H. Schwartz. *Extinct humans*. New York: Westview, 2000, p. 164f; newspaper (weekly): Zinkant, Kathrin. "Wenn Knochen spanisch sprechen." *Die Zeit*, online 4.6.2008. http://www.zeit.de/online/2008/13/atapuerca-hominine?page=all (last accessed 24 October 2009).

Rivera who covered the discoveries of Atapuerca for many years in *El País* was not aware of this criticism.[55] The same is true for the popular science books written by the Atapuerca researchers. The readers of these Spanish books learn little if anything about the doubts of other researchers with respect to the significance of *Homo antecessor*.[56] It is true Arsuaga reminds his readers that "paleontological species are of course always hypothetical." In the same vein Carbonell and Bermúdez de Castro state that there will always be a lot of quarreling when it comes to the assignation of (new) species.[57] Yet in many of their books and in particular in the Catalogs the Atapuerca researchers insert illustrations of the human genealogy that present the commanding position of *Homo antecessor* as a fact.

Needless to say, the Atapuerca researchers are very well aware that there are no "absolute truths or unquestionable and fixed dogmas" in human-origins-research to quote Arsuaga himself. Yet he makes this point with respect to *Australopithecus afarensis*. Whether this species of more than 3 millions years of age was our direct ancestor or not is only important for the "vanity of its discoverers."[58]

Conclusion: Atapuerca and Spanish national identity

In sum, there is a clear national slant to these narratives and in a double sense. First, Atapuerca has been instrumental in order to promote the discipline of human-origin-research in Spain and to lend it visibility and prestige abroad. And second, Atapuerca has become the new beginning of Spanish History however imaginative this may sound. The constant talk about "our ancestors" conveys the idea that our ancestors lived indeed in the Sierra the Atapuerca. It is true Arsuaga and colleagues keep trying to clarify that in their scenario we descend from the African lineage of *Homo antecessor* (and not directly from the hominids that lived in Atapuerca).[59] But this kind of differentiation has little if any impact. Not least because the researchers themselves publish popular books entitled *Atapuerca nuestros antecesores* (Atapuerca, our ancestors).[60]

At this point we should be cautious. Titles of books are often chosen by the publishers and may not always reflect the intentions and wishes of the authors. In 2008, Emiliano Aguirre, the "father" of Atapuerca, published a book entitled *Homo hispánico*.[61] He himself would have chosen a far more neutral title but the publisher wanted *Homo hispanicus*. Aguirre was horrified, because that would have meant to name a new species. So the title *Homo hispánico* was a compromise between the marketing-strategy of the publisher catering for a Spanish audience and a scientist sticking to his guns.[62] British paleoanthropologist Chris Stringer

55 Interview with Alicia Rivera, Madrid, 21 July 2009.
56 Yet in a public talk given in Barcelona on 2 June 2009 José María Bermúdez de Castro said that he himself does not uphold the "African scenario" any more, revoking claims he had made for example in one of his popular science books: Bermúdez de Castro 2004, 223.
57 Catalog 2004, 98; History 2004, 321.
58 Arsuaga 1999, 46f.
59 Arsuaga 1998, 304.
60 Catalog 1999.
61 Aguirre 2008.
62 Interview with Emiliano Aguirre, Madrid, 20 July 2009.

seemed to have had less scruples or had put up less resistance against his publisher's demand. His last popular science book is actually called *Homo britannicus*.[63]

That Atapuerca has become the new starting point of Spanish history in the past ten years may be best understood as a "co-production" of researchers and the public sphere. Media and in our case publishers used the results of the Atapuerca project to form new narratives. In how far researchers are active promoters of this transformation or rather reluctant, as for example Emiliano Aguirre, seems to depend on the individual researcher. Hence there is no "automatism" for this "nationalization" of human-origins-research but there is certainly a very strong pressure to comply with the "logic" of the media.

In many popular representations *Homo antecessor* is the first Spaniard to roam the Iberian soil. *Historia de España. De Atapuerca al euro* (2002); *Romancero de la historia de España. De Atapuerca a Los Reyes Católicos* 2004*; España. Una historia explicada desde Atapuerca hasta el 11-M* (2005) – titles of recent popular history books such as these do indeed suggest that Atapuerca has become the new starting point of Spanish history.[64] This shows that knowledge does not only travel in between science and the public sphere. Knowledge is in transit, to quote James Secord, in this case between different genres of popular science books, and is constantly transformed in the process.

63 Stringer, Chris. *Homo Britannicus. The incredible story of human life in Britain*. London: Allen Lane, 2006.

64 García de Cortázar, Fernando. *Historia de España. De Atapuerca al euro*. Barcelona: planeta, 2002; Campmany, Jaime. *Romancero de la historia de España.* Vol. 1. *De Atapuerca a Los Reyes Católicos*. Madrid: La Esfera de los Libros, 2004; Montero, Julio, and José Luis Roig. *España. Una historia explicada desde Atapuerca hasta el 11-M*. Madrid: CIE DOSSAT 2000, 2005.

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[Carbonell 2000a] Corbella, Josep, Eudald Carbonell, Salvador Moyà, and Robert Sala. *Sapiens. El largo camino de los homínidos hacia la inteligencia*. Barcelona: Península, 2000.

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Beyond Print:

Science Communication in the Early Audio-Visual Age

State-controlled multimedia education for all?
Science programs in early German radio*

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When in the early 1920s radio was established in many countries as a new medium for news, entertainment and education, visionary speeches on the great educational impact of the wireless communication were abundant. Worker could go to school at night, farmers in remote areas could get education or even the nation's universities would be opened to the whole people.[1]

Controversial content, however, that was in some way connected to political positions like discussion on current living conditions or economic judgments on local initiatives, often was excluded from the air. On the other hand broadcasts on science and technology were rather unproblematic to agree on and unlike choosing people from the arts or literature recognition as a scientist was both easy to evaluate for the program makers and easy to present to the listeners. Having a professor, an Academy president or a Nobel Price winner on the program was always a good choice. Scientific visions of a bright future were even a good environment for commercials and a respectable currency to pay back for private and state sponsoring of radio.

For these reasons it comes to no surprise that science programs can be identified in almost all channels right from the beginnings of radio. This is even less surprising if on takes into account that the early listeners to radio needed a certain technical aptitude to be able to receive the program given the shortcomings of stable reception and also the savings by self-made equipment. Moreover, the advent of radio meant for many people the beginning of their interest in science and technology; tinkering around with radio kits may have superseded battle play with tin soldiers.

This general outlook did, however, develop into very different forms of and opportunities for science programs in the early radio countries. German self-understanding of "Kulturnation" (being a cultural nation) and America's "unrestrained commercialism"[2] probably mark two of the most influencing contexts within which a system of radio with entertainment and educa-

* This is a slightly expanded version of my Budapest presentation, which can only give a first approximation to a necessarily more differentiated account which is still work in progress.

1 See below pages 173, 176.

2 Marcel C. LaFollette: A Survey of Science Content in U.S. Radio Broadcasting, 1920s through 1940s: Scientists Speak in Their Own Voices, Science Communication 24 (2002), 4-33, quote 5.

tion had to find its working scheme in the 1920s and 1930s. In any case, radio was a "medium"; but between what groups and interests did it actually communicate?

A look into the rich historical literature on radio does not give a general answer, in particular when it comes to science.[3] Surprisingly, despite the fact that history of radio has received such a great deal of interest in recent decades studies of science communication on the air are still scarce.[4] Also do available comprehensive studies of program history not always help to elucidate quantity and quality of science popularization on the radio since the typical categories in which science would be subsumed would simply be radio talks in general, educational programs or courses, broadcasts for schools or teachers more particularly, or special target group broadcasts and highbrow entertainment.[5] In consequence, we need to write the history of science communication not only in the case of print media for times in which the 19th century mode of popularization does not any longer apply, but also for the new media that were introduced during the 20th century, first radio and film and later television.

Historical research on early radio has focused much on political, economical and organizational questions of the institutional developments in national contexts as well as on programs on literary, musical and political content, thus relating to the main understanding of cultural history. History of science was at least not a core interest in these efforts.

In this article I would like to touch upon the following research questions that in different ways both relate to radio history and the history of science.

First of all, I discuss what (media) changes radio brought forth, when print not only met with radio in the competition for the interested reader or listener, but rather opened the opportunity for an alliance, i.e. the development of models of integration of print material and broadcasts into a kind of multimedia. How did print and radio adapt to one another with respect to formats, combinations, specializations or speed of communication.

Secondly, a comparative sketch of the different modes of instituting science communication on the radio is given that shows how differently nations like the US, Germany, France or even the Netherlands set up organization and control of radio programs.

3 For recent accounts see e.g. Konrad Dussel: Deutsche Rundfunkgeschichte, 2nd ed., Konstanz 2004, and Karl Christian Führer: A medium of modernity? Broadcasting in Weimar Germany, 1923-1932, The Journal of Modern History 69 (1997), 722-753, on Germany; George H. Douglas: The early days of radio broadcasting, London 2001, on the US, Andrew Crisell: An introductory history of British broadcasting, London 2002, on Britain; Christian Brochand: Histoire générale de la radio et de la télèvision en France Paris 1994, on France; Franco Monteleone: Storia della radio e della televisione in Italia, Venezia 1999, on Italy; Lorenzo Díaz: La radio en España, 1923-1997, 3rd ed., Madrid 1997, on Spain.

4 With the exception of Marcel C. LaFollette, who has provided in recent years seminal studies for the US case, in particular Marcel C. LaFollette: A Survey of Science Content in U.S. Radio Broadcasting, 1920s through 1940s (note 2); A Survey of Science Content in U.S. Television Broadcasting, 1940s through 1950s: The Exploratory Years, Science Communication 24 (2002), S. 34-71; Taking science to the market place. Examples of Science Service's presentation of chemistry during the 1930s, Hyle 12 (2006), S. 67-97; and her recent book-lenth account: Science on the air. Popularizers and personalities on radio and early television., Chicago 2008.

5 In Joachim-Felix Leonhard: Programmgeschichte des Hörfunks in der Weimarer Republik, 2 vols., München 1997, 352, the definition of talks was: "Als Vortrag ausgewiesene Wort- oder Wort-Musik-Sendungen beliebigen Inhalts, potentiell für alle Hörer; Wortsendung mit anderer Darbietungsform wie Gespräch oder Hörfolge, die wie der klassische Vortrag vorrangig der Belehrung dient. - Sparten: Allgemeines Vortragswesen, Organisiertes Vortragswesen, Kursprogramm."

The third section of this paper will then be concerned with the formats and genres of science communication that emerged in the German example, which is characterized by an particularly rich and diverse programming on science.

Finally, the question is raised what impact radio had on (national) systems of science communication and to what extent science – like literature, music or even sports – was embedded in the culture at least as far as it was represented on the air.

I. The many chances of a new medium

The history of early radio appears as a rather contingent development that was strongly influenced by the political and economical conditions after the Great War in which the main actors – program makers, radio stations and equipment suppliers – pushed their issues in a triangle of content, commerce and control. Radio opened many opportunities ranging from fostering democracy by easily making heard many voices or even giving everybody the opportunity to send out his or her views to simply making money by selling consumer products and media content to a unprecedentedly vast clientele.

For science communication it is important to notice that the beginnings of radio fell into times when the old models of science popularization were already transformed into new forms that, roughly speaking, reflects a shift from neatly getting the wonders of science presented to explaining how science works and to what extent a general scientific outlook may determine modern life. Or, as the British Science Guild put it in a notice to *Nature* in 1904:

> [The] purpose is to stimulate, not so much the acquisition of scientific knowledge, as the appreciation of its value, and the advantage of employing the methods of scientific inquiry, the study of cause and effect, in affairs of every kind.[6]

This early sign of 'scientification' now met a science based medium of communication and the early adopters thereof did hardly enjoy its values without some interest in science that might have excused the shortcomings of the reception. With this context in mind, let us consider three avenues that early radio could have taken in order to establish itself as a medium of science communication.

1. Adapting from Print

If we look at the South German radio corporation at Stuttgart during 1925, we can find an example of seamless adaption. At the same place the Franck publishing house has printed the journal Kosmos, which became the best-selling popular science publication in Germany with 200.000 copies per month in the 1920s. Science writer Kurt Floericke[7] had a been writing for 20 years articles in Kosmos, mainly on botany and zoology, and participated in the weekly lecture series the Kosmos society organized for its member which were the subscribers of the journal.[8] Now in 1925 the Süddeutsche Rundfunk AG would broadcast the Kosmos lectures

6 Quoted from Frank Turner: Public science in Britain, 1880-1919, Isis 71 (1980), 589-608, on 601.

7 On Floericke see Kosmos 26 (1929), B19.

8 For a discussion of *Kosmos* in German culture cp. Arne Schirrmacher: From Kosmos to Koralle. On the Culture of Science Reading in Imperial and Weimar Germany, in: Cathryn Carson/ Alexei Kojevnikov/ Helmuth Trischler: Quantum Mechanics and Weimar Culture: Revisiting the Forman Thesis, London 2010.

Toni Kellen	1925	Kosmos-Vortrag: Der deutsche Wald im Winter	Mo., 5.1. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Dr. Curt Floericke	1925	Kosmos-Vortrag: Vom Winterschlaf der Tiere	Mo., 12.1. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Robert Hesseling	1925	Kosmos-Vortrag: Der Lebensprozeß des Weltganzen	Mo., 19.1. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Dr. Curt Floericke	1925	Kosmos-Vortrag: Beim Emir von Buchana	Mo., 26.1. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Präzeptor G. Klotz (Cannstatt)	1925	Kosmos-Vortrag: Allerlei von Mutter Erde	Mo., 2.2. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Hermann Radestock	1925	Kosmos-Vortrag: Anfänge der Tierzucht	Mo., 9.2. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Tony Kellen	1925	Kosmos-Vortrag: Die Wunder der Kohle	Mo., 16.2. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Dr. Curt Floericke	1925	Kosmos-Vortrag: Tierleben der Polarwelt	Mo., 23.2. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Hermann Radestock	1925	Kosmos-Vortrag: Schwerkraftstörung in der Erdrinde	Mo., 2.3. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Dr. O. Paret	1925	Kosmos-Vortrag: Geheimnisse der Vorzeit und ihre Aufhellung	Mo., 9.3. 19:30-20:00	Stuttgart: Süddeutsche Rundfunk AG
Tony Kellen	1925	Kosmos-Vortrag: Aus der Geschichte des Papiers	Mo., 16.3. 19:00-19:30	Stuttgart: Süddeutsche Rundfunk AG

Fig. 1: 1926 Title page of "Kosmos" and listing of "Kosmos" radio talks, Jan.-Mar. 1925

every Monday at 7:30 in the evening, thus at prime-time, and Floericke alone spoke eight times that year (Fig. 1).

Interestingly, this way of extending authors and content from print to radio is rather the exception than the rule. And even in this exceptional case radio programs did not match directly with the printed articles nor did the journal directly point to any related broadcasts. From my analysis of roughly 1200 popular science programs in German radio during the Weimar period almost no other clear pattern of a simple adaption of format and personnel from print to radio is visible and we must hence assume that the new medium also was mainly run by new people looking for new formats.

2. The Chance of Multimedia

The first German station on air was the Berlin Funkstunde AG which started regular broadcasts on October 29, 1923. In its third month of operation Hugh Iwan Gramatzki had his first program on astronomy – at least according to available program listings that were very sporadic in the first month – and he was realizing immediately, that he could not compensate for the lack of visual presentation by auditive means only.

Gramatzki, however, when he was talking about the moon a couple of month later, had solved the problem in a multimedia fashion:. His listeners now were prepared, at least those who were reading the radio magazine *Der deutsche* Rundfunk (Fig. 2). With one Mark[9] for the four weekly copies it was reasonably prized if one considers that the radio license fees were 2 Marks a month.

In a later contribution to *Der deutsche Rundfunk* Gramatzki explained the "simplest solution, at least for the time" which he found to the "plight": having the illustrations published beforehand in the radio magazine. This, in addition, is a welcomed means to direct the attention of

9 25 Pf, later 40 Pf.

the listener fully to the broadcast with ears and eyes well provided for. Finally, the immaterial voice leaves a material reminder keeping the message alive.[10]

In this way the advantage of the combination of media is obvious and the reciprocal reference between print and broadcast might have been favorable for both media. However, the problem of insimultaneity is obvious, neither would the pictures in the radio magazine convey much of the scientific content of the radio broadcast (only if it would tell so much that it renders the broadcast unnecessary) nor could the radio speaker presuppose that the listener is actually having the illustrations at hand.

Fig. 2: Program Journal "Der Deutsche Rundfunk" providing illuminations for a science program on Berliner Funk-Stunde by H. I. Gramatzki, broadcast on March 31, 1924

3. Radio – the faster Medium?

Speed of reporting should be at least one definite advantage of radio over print. But if we look at the reporting of the spectacular balloon flight of Auguste Piccard into the stratosphere on 27th of May 1931, German radio seemed not to be prepared. Otto Willi Gail from the Munich Funkstunde was present at the start in nearby Augsburg as were many newspaper reporters, who other than Gail tried to locate Piccard after his flight by plane. Gail's radio broadcast was excellent, a critic wrote, but he was late by 24 hours. Instead of taking the chance of reporting Piccard's unknown fate – had he survived the flight? – late at night, this was left to the morning editions of the newspapers. Later Gail tried to make good on this missed opportunity by bringing Piccard into the radio station for a special program.

Thus, contrary to common assumption, here Weimar radio did not contribute to a development of medialization, that made generally news values rule over content and quality. Control and cultural values still determined a medium for which it was not vital to beat the press in speed.

Before I delve more deeply into this emerging opportunities of science communication, I should put into context the development of German radio.

10 H. J. Gramatzki: Der Rundfunkvortrag mit Bildern, Der Deutsche Rundfunk 2 (1924), 1034.

Der Flug in die Stratosphäre

Sowohl im Freiballon als auch im Flugzeug sind schon über 13 Kilometer Höhe erreicht worden, doch ist beabsichtigt, die großen Flugrouten in noch höhere luftverdünnte Schichten, in die sog. „Stratosphäre“ zu verlegen, um noch größere Reisegeschwindigkeiten zu erzielen.

Die Stratosphäre, welche von etwa 15 bis 25 Kilometer Höhe angenommen wird, bietet den für den sicheren Luftverkehr sehr bedeutsamen Vorteil, daß sie von Witterungseinflüssen, wie Stürme, Regen, Schnee oder Nebel ständig frei ist und infolge der viel geringeren Luftdichte dem Flugzeug einen geringeren Widerstand entgegenstellt, als die Luftschichten in Erdnähe.

Die zu überwindenden Nachteile sind jedoch die in diesen Regionen herrschende große Kälte (?) und der Mangel an Sauerstoff, welcher für die Insassen und für den Betrieb der Motoren unbedingt notwendig ist. Diese Schwierigkeiten sind jedoch nicht so groß, als daß sie nicht durch technische Hilfsmittel überwunden werden könnten. Alle führenden Fachleute sind sich darüber einig, daß das Fliegen in 15—25 Kilometer Höhe ohne Gefährdung der Insassen möglich ist.

Das Stratosphärenflugzeug wird in seiner äußeren Form den bisher gebräuchlichen Flugzeugtypen ähnlich sein, jedoch in seinem Inneren eine Reihe neuer, sehr wichtiger Apparate und Maschinen erhalten müssen.

Der Führerraum sowie die Kabine für die Fluggäste müssen von außen hermetisch abgeschlossen sein. Durch künstliche Lüftung und Temperaturregler müssen der Luftdruck sowie die Luftzusammensetzung und die Temperatur stets in normalen Grenzen gehalten werden. Besondere Sauerstoffgeneratoren werden die Innenräume ständig mit Frischluft versehen, während die verbrauchte kohlensäurehaltige Luft von Luftreinigern angesaugt und aufgezehrt wird. Die Motoren, deren Leistungen bekanntlich in großer Flughöhe stark abnehmen, werden Spezialkompressoren erhalten, durch welche den Zylindern ein vorgewärmtes und verdichtetes Gasluftgemisch zugeführt wird, so daß die Motoren auch in großer Höhe mit ihrer Normalleistung arbeiten können. Schließlich muß der Propeller durch automatische Verstellung seiner Schaufeln eine veränderliche Steigung erhalten, damit sein Wirkungsgrad den jeweiligen Verhältnissen angepaßt werden kann.

v. R.

Der Rundfunk allen voran?
Oder: 24 Stunden zu spät!

Am Mittwoch, den 27. Mai 1931, in den ersten Morgenstunden war Prof. Piccard mit seinem Assistenten Dr. Kipfer zu dem denkwürdigen Flug gestartet, der uns alle eine Nacht voll banger Erwartung und Sorge verbringen ließ.

Otto Willi Gail, der den Start in Augsburg miterlebte, hatte ihn nur wenige Stunden später den Hörern des Bayerischen Rundfunks schildern können. Als dann in den Abendstunden die weiteren Meldungen über den Verlauf der abenteuerlich anmutenden Fahrt kamen, als man nicht mehr wußte, ob Piccard in seiner Metallkugel überhaupt noch am Leben war und der Ballon von einem stetigen Wind immer weiter nach Süden getrieben wurde, da rasselte im Funkhaus unumter-

Rechts:

Der Ballon Piccards

1. Ventil.
2. Reißleine, doppelt gesichert.
3. Reißbahn.
4. Lochtaschengurt.
5. Hülle aus einfachem gelben Ballonstoff, einseitig gummiert.
6. Parabelbogengurt.
7. Füllansatz.
8. Ansatzring.
9. Stoffstutzen für Reißgurt.
10. Stoffstutzen für Ventilleine.
11. Pöschelansatz mit Aufziehvorrichtung.
12. Auslaufleinen.
13. Korbringleinen mit Knebel.
14. Korbring.
15. Kugelförmige Aluminiumgondel.

Zeichnung H. u. B. v. Römer

Fig. 3: Bayrische Radiozeitung reporting on Piccard’s stratosphere flight and discussing the missed opportunity of radio reporting it, issue of June 7, 1931

II. National modes of instituting radio science communication

The history of radio is a unique story for every single country a giving different weight to the main actors program makers, radio stations, equipment suppliers and political influence. In the triangle of content, commerce and control I will try to briefly sketch the respective positions, however, limited to the different beginnings of radio in Western countries.

1. The liberal model with some state intervention: US radio

The main example of how a liberal system of radio developed in Western countries is the American and due to the seminal work of Marcel C. LaFollette we have already a rather clear picture of the development of science communication in early radio under the liberal and commercial conditions that this democratic society provided.[11] Also in the US it took until the 1920s that radio as a medium of mass communication set out and many stations went on the air. Receivers improved steadily and became affordable for wide parts of the population. Broadcasting was done by privately organized Corporations and hence we should assume that like in print commercial aims must have had its influence also on science programs. At that time, however, many observers expressed the hope that public good and commercial interest could be reconciled.

As in many other countries also in the US the main task of radio was identified to become a national institution for education that allowed experts to inform an interested and willing audience in talks. Workers could "go to night school" in this way and scientists would demonstrate their "latest discoveries", this at least was the vision NBC founder Davis Sarnoff entertained in a newspaper article in 1926. Radio stations that specialized on education, however, did not fare well in the US, finances turned out to be the biggest problem for stations like the University of Pittsburgh station that broadcast radio talks by university professors from 1924 to 1930 on topics ranging from modern physics and chemical catalysis to science in the kitchen. Interestingly, it were commercial reasons that made it possible to print some of the lectures and distribute it to listeners since advertising found here a particularly interesting group of prospective customers for various goods.[12]

Since broadcasting stations were private – and in principle anyone could run one, similarly to the print business – revenues could only be made by advertising. In practice, however, only two big players emerged in the US the networks NBC and CBS. NBC grown out from industry, while CBS came from artist agencies. For programs other than entertainment, this is educational programs in general, the funding question was primary and hopes that the new medium would allow workers to "go to night school"[13] by listening to the radio did not come true. Hence also for science content a sponsor was needed always, being it a National Advisory Council on Radio in Education or the Science Service, that both relied on donations, or it

11 Here I follow mainly LaFollette, Survey (note 2). More detailed and with a stronger emphasis on individual actors see LaFollette, Science on the air. (note 2).

12 LaFollette, Survey (note 2), 8 and 9.

13 LaFollette, Survey (note 2), 8.

were General Electric, General Motors or the U.S. Rubber Company. Public radio did not arrive before half a century later in 1970.

In consequence, rhetoric and reality where not always able to match in the early decades of US radio. The Nobel Prize winner Robert Millikan, speaking in 1931 for the Rockefeller and Carnegie funded National Advisory Council on Radio in Education (NACRE) pointed out that "radio seems to be already showing that it contains within it the possibility of exerting an influence toward introducing more rational, less emotional thinking and acting into American life." At the same time one of the most widely heard science broadcasts were the intermission talks on "dramatic stories of science." Did it really need the New York Philharmonic in order to lure an audiences into listening to a few minutes of popularized science?[14]

2. Western Europe

In France among other models the name RADIOLA stood for a close connection of electric industry and radio program. Both the receivers of the company SFR and the radio station, that served to promote the purchase of the receivers, were called RADIOLA, only the rather famous speaker had a different name, he was called Radiolo.

In the Netherlands, that started similarly with company stations promoting their product, again a different model can be found. Organization and production of the radio program was done by listeners' associations. And when more and more of them, often aligning to some religion, ideology, etc., demanded broadcasting time a typical dutch sharing system was introduced

US	Networks	Commercials, Industry Sponsors, Foundations, Donations	Entertainment => Science as "intermission talks"
GB	Company BBC Corporation	Fees (no commercials)	Independence
F	Electric Industry	RADIOLA System ...	Program = Promotion for Equipment
NL	Listeners' Associations	Sharing of Air Time	Participation, Plurality
D	State	Fees (subsidizing state) no Market no Participation	(High-)Culture, Education => Science as integral part
...	...	...	...

Fig. 4: Rough sketch on different models of radio organization

In Britain due the developments witnessed in the US a slightly different private approach was followed. Basically six larger companies formed the British Broadcasting *Company*, that got the license for a rather high-quality, no advertising program following a public service philosophy and a cooperative scheme for broadcasting. Money was earned from listeners' license fees as well as from selling receivers, at least initially. As early as 1927 the state bought the

14 LaFollette, Survey (note 2), 10-11 and 25-26.

stations and formed under a Royal Charter the BBC, being now British Broadcasting *Corporation*, which was meant to be free from commercial pressures as well as from political intervention.

3. The untypical state-controlled system: German radio

While everywhere else, as it seems, radio started by private initiative and was at least in part market driven, in Germany no connection between industry and program was present and also no private person or association could go on the air. Although after the Great War a democratic order was established radio that started in 1923 did not show anything democratic or liberating. The fragile republic with frequent changes of the politicians in charge accustomed itself to a law-and-order philosophy that meant strict supervision of all radio organization and content. Industry man Hans Bredow (Fig. 5) became director for telegraphy at the national postal service and constant promoter of radio with high cultural profile.[15] Censorship was banned by the new constitution which meant a rather free and diverse press but there was the exception of film and, one might have guessed, later also of radio. Control boards were set up to keep political controversy out of the air and concerning cultural or scientific content one tried to arrange for balanced coverage. Strictly enforced listeners' fees did not only finance the program and infrastructure they actually subsidized state finance substantially. The only unknown missing in this equation seems to be the audience.

Fig. 5: Hans Bredow (1879-1957) in a broadcasting studio

15 On Bredow's own view, see Hans Bredow: Mein Weg zum Rundfunk. Ein Lebensrückblick, Wiesbaden 1949, and Hans Bredow: Im Banne der Ätherwellen. vol. 2: Funk im Ersten Weltkrieg. Entstehung des Rundfunks, Stuttgart 1956.

Although the simplification of the German development to a single actor distorts the whole picture and is usually instrumentalized to create founding myths,[16] here it might be sufficient to show to which extent Bredow instilled the idea of a German nation of culture into his work. In *Der deutsche Rundfunk* he explained in January 1925:

> Only a well thought-out series of lectures, that treat scientific questions with utmost care and explain step by step, can raise general understanding in the audience. It is not impossible that some time we will have the lectures of our professors broadcast directly from the their lecture desk and in this way open our universities to the whole people.[17]

And like university and all general education also radio and science communication by means of radio was a matter of the state. Market forces only took effect in the equipment and unlike e.g. France, radio industry and programming was completely separated, content did not have to compete. Furthermore, also amateur radio was blocked and the local radio club would meet only to listen but not to make radio.

It was characteristic for the German case that there was no public participation in the founding of radio and although the German stations that reflected the federal structure were stock corporations, 51% of the shares were always held by the German state through the Postal Service and after 1932 German radio became fully nationalized.[18]

How did this state-controlled program look like? First of all it was different from station to station, however, the quantity of science programs were high everywhere. While the Stuttgart station had its weekly Kosmos lectures, the Munich *Funkstunde* in 1925 spread the programs over the whole week (Fig. 6). It is also telling that science programs occupied mainly prime-time, e.g. in Berlin and Munich (Fig. 7).

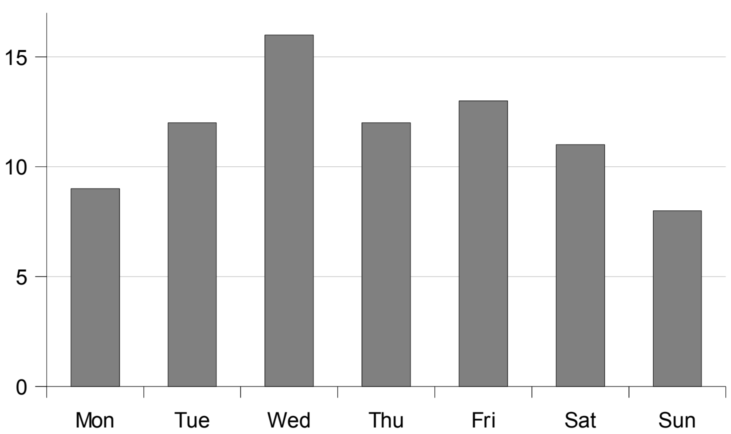

Fig. 6: Distribution of science programs on days of the week for Munich's "Deutsche Stunde in Bayern" in 1925 (total 81 broadcasts)

16 Jürg Häusermann: Geschichte des Hörfunks. Script zur Vorlesung im Aufbaustudiengang Medienwissenschaft - Medienpraxis, Tübingen 2004, 47.
17 Paraphrase in a report, Der deutsche Rundfunk 3 (1925), 20-21, on 21 (4. Jan. 1925).
18 Häusermann: Geschichte des Hörfunks (note 16), 49-55.

This, however, was not so much due to the listeners' demand – there were many complaints about the evening program and workers and employees requested "light" entertaining music – but it was the radio policy of the *Kulturnation*.[19] The rather general reason had also a particular motive. It was no accident that the new head of the Central Institute for Training and Education of the German Radio (Zentralinstitut für Erziehung und Unterricht) Hermann Schubotz who came from the ministry of culture gave his speech on "Broadcasting and knowledge communication" at a conference that was organized to fight "trash and dirt literature and the rampage of the cinema".[20] It was in particular the new medium cinema that did not perform to the likings of the officials. Hence, cheap diversion was to be avoided at all cost in the German radio. Schubotz, who was a convinced democrat, was responsible for the *Deutsche Welle*[21] a nationwide radio station that had the task to promote its program "to a level that is in cultural respect the highest conceivable" which clearly echos Bredow's words. [22]

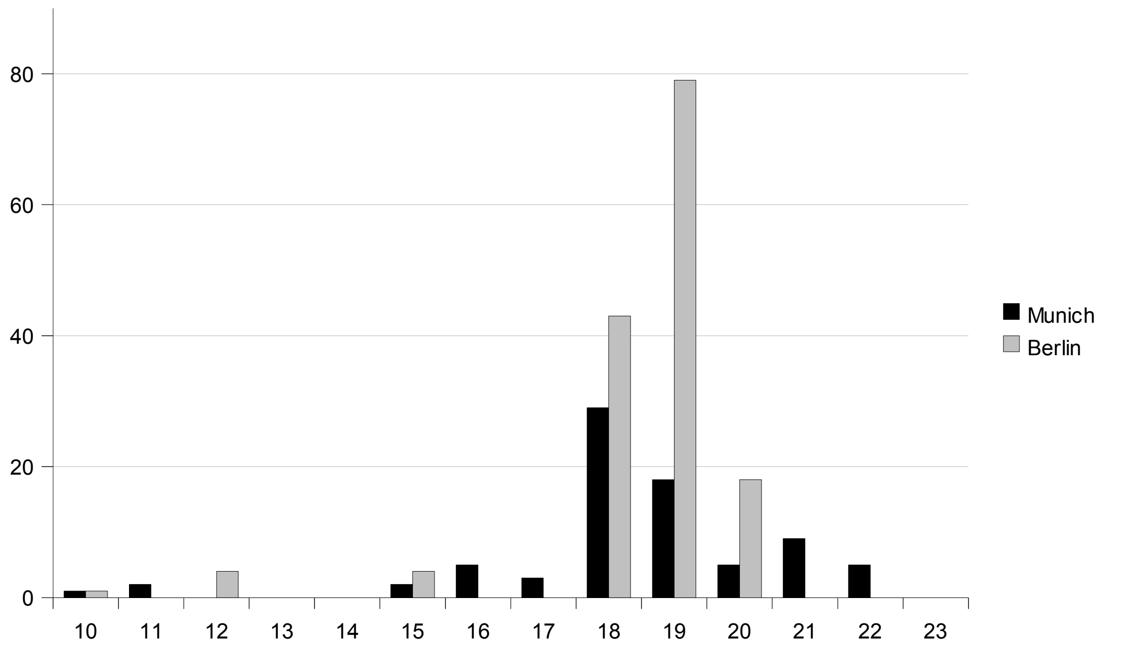

Fig. 7: Distribution of science programs over the day for Munich's "Deutsche Stunde in Bayern" and Berlin's "Funkstunde" in 1925

19 For a lucid analysis of 'higher things' and entertainment in Weimar radio see Führer: A medium of modernity (note 3), 742-753.

20 The conference was titled "Tagung des Berliner Auschusses zur Bekämpfung der Schund- und Schmutzliteratur und des Unwesens im Kino" and took place on Oct. 15, 1926, see Hermann Schubotz: Rundfunk und Wissensvermittlung, D.W. Funk 4/1926, 125-127.

21 There is no direct link to today's foreign radio service of Germany with the same name.

22 "... auf eine in kultureller Beziehung denkbar hohe Stufe zu bringen." quotation of Ernst Voss in Leonhardt: Programmgeschichte (note 5) , 124.

III. Genres of radio science (communication) – the German example

1. Pedagocical, vocational and general educational program

While the quote from Hans Bredow, that radio would eventually let the whole nation attend university, reflected a widespread rhetoric of the potential of radio in many nations, probably the Germans came closest to it. First of all, this meant in principle a clear renunciation of the growing group of journalists and professional popularizers (like Floericke and others from Kosmos etc.) or of those journalists that founded an technical-literary association of science writers that had established themselves in the growing popular science print media and newspaper sections.[23] On the air the authentic scientists or engineers should speak for themselves again and the program listings duly reported together with the name of the speaker his – and it was mostly a he – his qualification and institution.

Secondly, one has to take into consideration that early radio did not mean that in every household a receiver with a loudspeaker would be present. Besides the many amateurs with their headphones and constantly adjusting their receivers for good reception, public community listening was organized, which made the radio experience rather similar to going to a concert or a talk. Consequently, the most ambitions effort for educational radio was done with the aim to provide schools and communities with "Volksbildungsmitteln", with means to educate the people. This effort then materialized in 1926 in the *Deutsche Welle*. Every listener in Germany would now get, in principle at least, the choice between two programs at the same time, which meant in the words of one of the managers of the Deutsche Welle: "Then the radio listener has the opportunity – according to his respective needs or momently mood – either to get entertained or to listen to a science communicating talk or to work on his extended vocational training."[24] Pedagogical, vocational, and general educational programs would occupy accordingly earlier or later hours in the timetable of Deutsche Welle.

It is a remarkable fact that despite of this national educational station in place the nine federal broadcasting stations did not reduce their air time on science. The Berlin *Funkstunde* kept its science content of two or three broadcast every week on the average. Thus we find instead within the strict state controlled framework many innovative approaches for formats of science communication. Plurality not uniformity did reign radio science as, by the way, it also was the case for science in German popular print. In this way the commercial competition was replaced in part by a contest of the various regional stations which actually had to compete more and more for listeners as the reception quality for distant stations steadily improved.

This, however, may also explain to some extent why radio did not compete with print media and the competition on speed of publication as discussed in the Piccard example was not a central issue of radio makers.

23 Cp. Hans Christian Förster: Am Anfang war die Teli. Journalismus für Wissenschaft und Technik, Berlin 2007.

24 Hans Roeseler: Die zukünftige Tätigkeit der "Deutschen Welle", D.W. Funk 1/1926, 1-2, on p. 1.

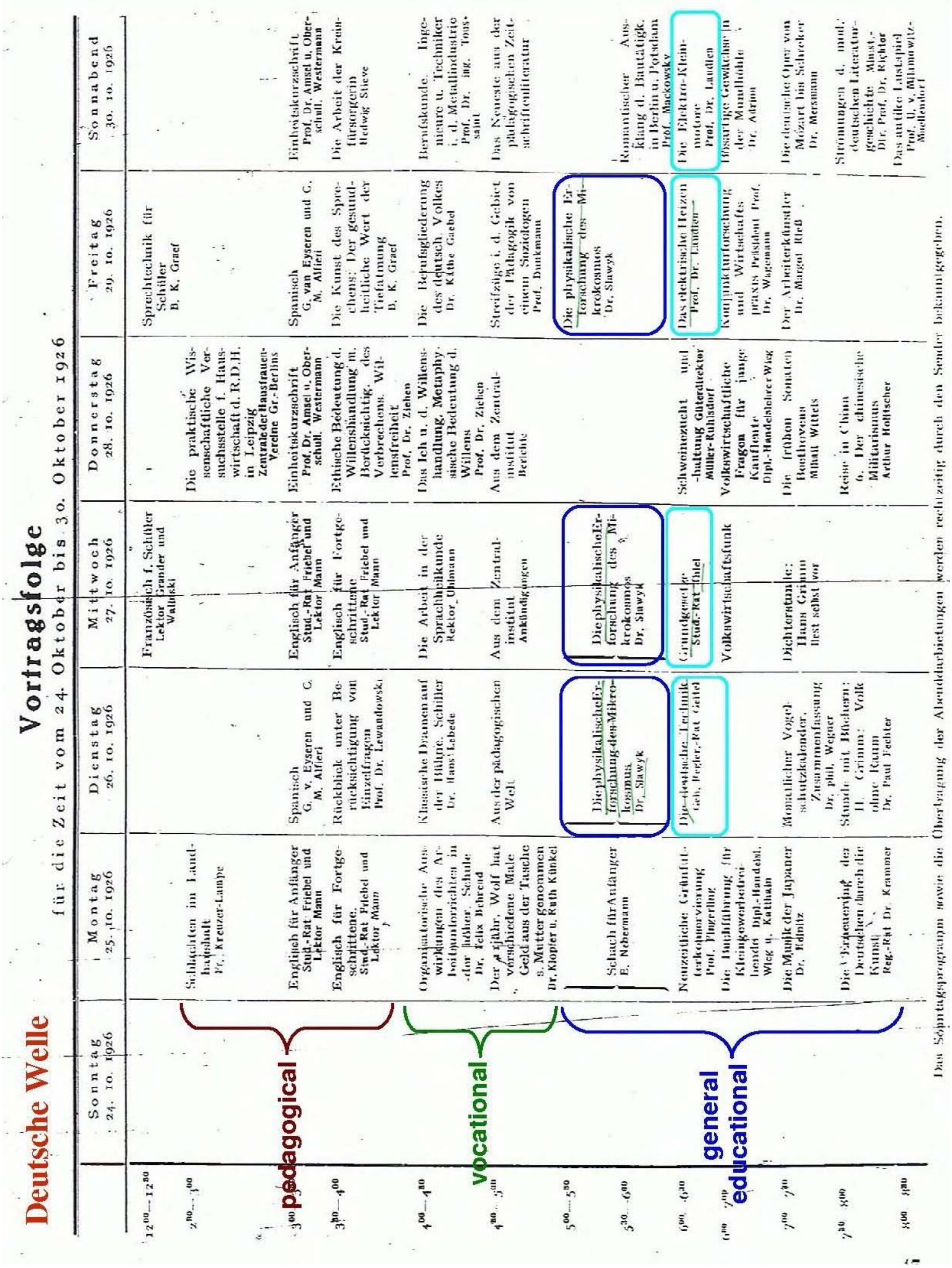

Fig. 8: Broadcasting schedule of Deutsche Welle for a week in Okt. 1926. Pedagogical, vocational and general educational programs occupy different time slots. Even general educational programs were often organized in series of talks, here marked in blue.

(Source: D.W. Funk. Rundfunkmitteilungen der Deutschen Welle G.m.b.H. und des Zentralinstituts für Erziehung und Unterricht, 2/1926, 47.)

3. Plauderei, Hörbericht, Mikrophonstreifzug – new formats for broadcasts

While *Deutsche Welle* mainly stuck to the format of talks or series of talks, the federal stations tried to find more innovative formats for science programs. A typical and widespread format – which was actually adapted from newspaper writing – was the "Plauderei", something between chat, causerie and gossip. At least it was not a formal lecture and it was rather about science and scientists, so the journalists and popularizers found a way back in.

Interestingly, these "Plaudereien" were not necessarily superficial. One series from the engineer Joachim Böhmer was even called "the critical engineer," though "critical" would not yet mean to question the autonomy of science in a radical sense but rather characterizes a keen interest in what science is able to do. Apart from typical topics of the natural sciences also issues of hygiene and medical questions were presented as "Plaudereien".

Ingenieur Joachim Boehmer	1925	Der technische Ingenieur (Technische Wochenplauderei)	Mon., 2.2. 18:40	Berlin: Funkstunde AG
Vortragszyklus von Prof. F. Schmidt (Technische Hochschule Karlsruhe)	1926	Photographische Plaudereien II. Vortrag	Wed., 27.5. 20:00-20:30	Frankfurt: Südwestdeutsche Rundfunkdienst AG
Dipl.-Ing. Georg Zimmermann	1926	Technische Plauderstunde: Flüssige Kohle. Ein großer Erfolg deutscher Forscherarbeit	Sun., 19.12. 16:20	München: Deutsche Stunde in Bayern
San. Rat Dr. Paul Frank	1926	Medizinisch-hygienische Plauderei	Sat., 13.2. 18:45-19:15	Berlin: Funkstunde AG
Max Mengeringhausen	1927	Technische Plauderstunde: Die Reise nach dem Mond	Mon., 6.6. 15:15	München: Deutsche Stunde in Bayern
Heinz Gelhar	1935	Die Geburtsstunde des Fernsehens. Plauderei über Paul Ripkow	Fr.i, 19.7. 18:55	München: Deutsche Stunde in Bayern
Hans Gerhard Meyer	1956	So sehe ich meine Zeit: Eine technische Plauderei	Wed., 15.02 16:40-17:00	Berlin: RIAS I

Fig. 9: Selection of program called "Plaudereien" in German radio

The *Deutsche Stunde* from Munich introduced in 1929 the format "Hörbericht Wissenschaft", audible reports on science as a "brief and relaxed comprehensible form" of topical science communication. The radio magazine criticized the first couple of broadcasts as "a bit sluggish and unpleasant". When later Otto Willi Gail took over the presentation things improved. Gail, a physicist who also wrote a number of science fiction novels, can be seen as one of the early radio reporters, who left the studio to speak from authentic places of science and technology but also from the living room. Gail became one of the most prominent science reporters in the 1930s and his way of presenting science did, as it seems, only thrive in the first years of National Socialism. In 1934 he started to stage his reports as debate with a colleague and in 1935 he started "microphone excursions though the research scene of science" thus meeting the scientific workers in the lab.[25] – Many others, however, weren't heard anymore after 1933.[26]

Otto Willi Gail	1929	Hörbericht Technik: Drollige Patente - Die Tausendstel Sekunde - Flugzeuge landen auf fahrenden Schiffen - Schleudernde Kraftwagen	Fr., 8.11. 19:30	München: Deutsche Stunde in Bayern
Otto Willi Gail	1932	Technische Zeitfragen: Zickzackwege der Technik - Windmühlen werden wieder modern - Eis als Baustoff - Fernsehfunk auf Lichtstrahlen - Magnetische Straßenreinigung und andere Kleinigkeiten	Mo., 11.4. 18:45	München: Deutsche Stunde in Bayern
Otto Willi Gail	1934	Arbeiter im Laboratorium: Ein Streifzug durch die Forschungsstätten der Wissenschaft. I. Teil: Das Königspaar in der Glasflasche - Im Inneren einer Kurbelwelle - Stahl wird zerrissen - Ein Zehntausendstel Millimeter - Der Mann, der Elefanten macht	Do.,15.11. 19:35	München: Deutsche Stunde in Bayern
Otto Willi Gail	1936	Der Physiker geistert durch den Haushalt. Ein Gespräch mit Otto Willi Gail	Do., 16.7. 19:45	München: Deutsche Stunde in Bayern

Fig. 10: Some examples of "Hörberichte" by Otto Willi Gail

IV. Outlook

1. The impact of radio: Science in Culture and Culture into Science

Much has been written on the Crisis years of Weimar Germany and historians of science, in particular those of physics, have discussed the interaction of science and society. Particular attention received the so-called Forman-Thesis, that theoretical and atomic physicists in Weimar Germany were confronted with a "hostile intellectual environment". And scientists then tried to adapted to this "cultural milieu", that was marked by philosophy of life, dismissal of causality etc.[27]

Interestingly on radio we don't find a confrontation of science and culture, we rather find a perfect immersion of science into culture in general. Just look at the Munich programs on 28th of April 1931: concert, opera, a women's program etc. met seamlessly with a talk on

25 Arbeiter im Laboratorium. Ein Mikrofonstreifzug durch Forschungsstätten der Wissenschaft; Das Königspaar in der Gasflasche - Im Inneren einer Kurbelwelle - Stahl wird zerrissen - Ein Zehntausendstel Millimeter - Das Auge der Kamera (Übertragung nach Berlin), 11Jan. 1935.

26 Although radio in Nazi Germany is a strongly researched field of German history, information on popular science almost absent. Cp. Clemens Zimmermann: Medien im Nationalsozialismus. Deutschland, Italien und Spanien in den 1930er und 1940er Jahren, Wien 2007. Inge Marßolek/ Adelheid von Saldern (eds.): Zuhören und Gehörtwerden I. Radio im Nationalsozialismus zwischen Lenkung und Ablenkung Tübingen 1998.

27 Cf. Carson et al. (eds.): Quantum Mechanics and Weimar Culture, with Schirrmacher: From Kosmos to Koralle (note 8).

Fig. 11: Bayrische Radiozeitung, covering as diverse topics as opera and atomic physics side by side

"Constitution and decay of atoms" held by the Munich professor Kasimir Fajans. The radio magazine devoted much room for illustrations to the talk – multimedia again – but this was exactly on a par with the coverage of the opera transmission later that evening, Cimarosa's "The secret marriage". The stage photos and text length are very much the same (Fig. 11).[28]

This result, however, should not be misinterpreted to mean that there were no influences – political and cultural – on the program. Even the *Deutsche Welle* with its sophisticated structure and oversight did only on a superficial level create a balanced program. When after two years of operation they analyzed their program, they nicely were able to show how well they covered each area of importance, ranging from science and technology over music, arts and literature to political education and religion in the field of general educational talks that were broadcast between 5 and 8 pm. (Fig. 12).

However, already one year earlier the *Deutsche Welle* had confessed, that there was some kind of "hidden systematics" when it came to science programs and it comes to no surprise that despite the lack of democratic participation of the listeners still some of the most widely discussed topics of the time are mirrored in the programming:

> Intentionally we confined ourselves to a certain hidden systematics [...] which became only apparent in the course of the events: Just recall the lectures on "raceresearch", "cell and heredity", "theory of decent", "the race elements of the German people" [...][29]

28 Bayrische Radiozeitung 13/1931 (29 Mar. 1929), p. 437-438, modified title taken from program listing.
29 D.W. Funk 1/1927 (1. Jan. 1927), 1-3, on p. 2.

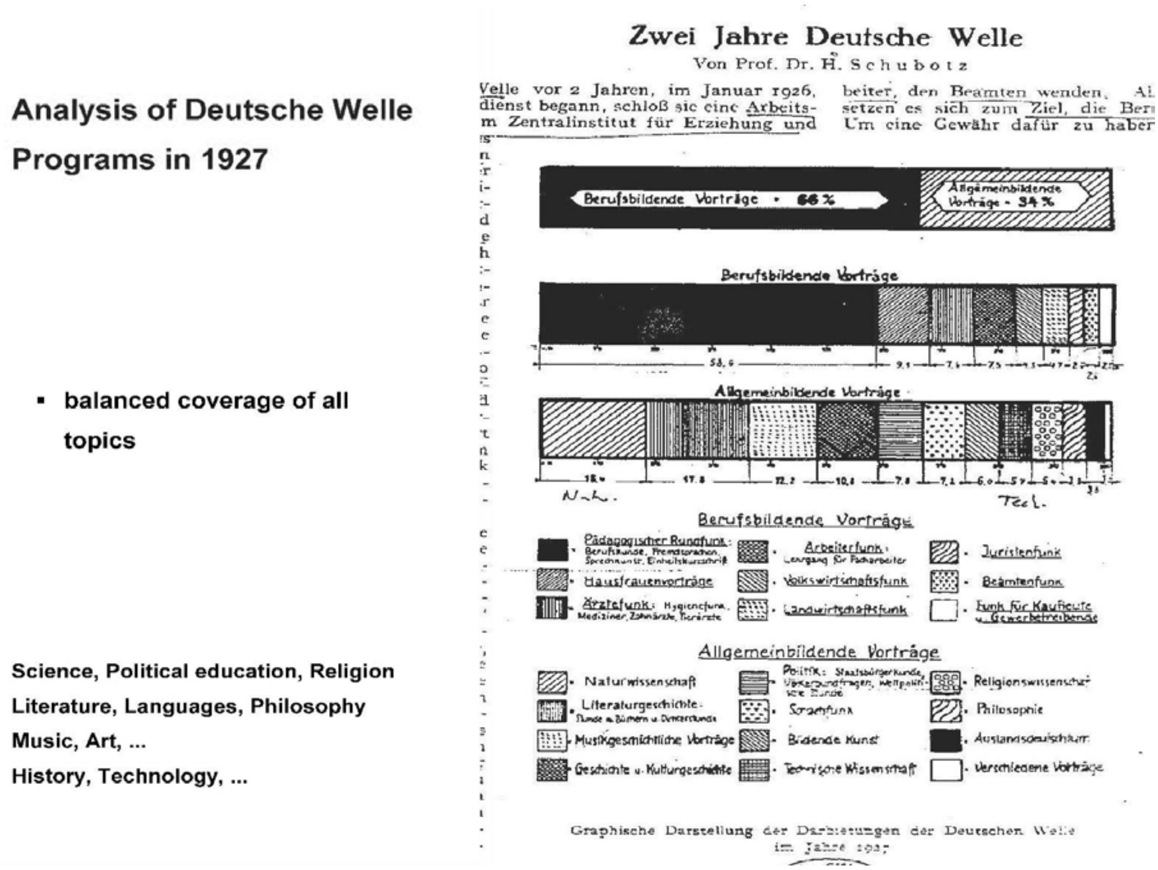

Fig. 12: Deutsche Welle program analysis published in D.W. Funk 1/1928,1-3, here p. 1.

In this way Weimar radio probably played an important role to amplify the otherwise already present discourse on race and heredity.[30]

In the Germany of the interwar period much science was on the air. On the reception we know rather little[31] but everything hints at a close integration to high-culture in general. Most interesting, however, is the question whether the radio phenomenon or the radio experience exerted influences back into science. At least do we have many examples that radio influenced scientists. Some of them were able to earn good money which helped them in their researches or career. Some of them – maybe a whole generation – were drawn into science by putting together a radio kit.

Scientist-philosopher Hans Reichenbach in turn transformed his radio talks into books, while Manfred von Ardenne was just 18 years old when he first presented a program on radio technology and its scientific base in 1925[32]; later he would make important inventions in amplifier and electron optics technology. And also for the focus of the *Deutsche Welle* on heridty and eugenics we might assume that it contributed to ideas, motivations and recognition of scientific research as it amplified the perception of a crisis that spread from economic to biologic fields.

30 For a discussion of the programs with eugenic topics cf. Gabriele Rolfes: Die Deutsche Welle - ein politisches Neutrum im Wiemarer Staat?, Frankfurt 1992, section 5.3, 137-146.

31 Again radio journals provide some insight as they occasionally print program reviews and criticsm.

32 Manfred von Arednne: Die Physik der Glühkathodenröhre (Hans-Bredow-Schule, Abteilung Bildungskurse der Funk-Stunde, Technik), broadcast from 30 April 1925 at 18.40 on the Berlin *Funkstunde.*

KRUTNAVA

DIE ERSTE NATIONALE SLOWAKISCHE OPER VON EUGEN SUCHON

. unserer Opernsendung am Sonntag, 19.50 Uhr, Berlin I

...tnava", zu deutsch „Seelenwirbel", ist die erste ...nale slowakische Oper. Ihr Schöpfer, der be...nte, heute 46jährige slowakische Komponist ...en Suchon, hat sich mit diesem realistischen ...k in die vorderste Reihe der Opernkomponisten ...erer Zeit gestellt. Bereits im Jahre 1949 wurde ...Oper in Bratislava zum ersten Male mit außer...entlichem Erfolg aufgeführt. Bei den internatio...len Musikfesten „Prager Frühling" in den Jahren ... und 1953 wurde sie stürmisch bejubelt. Eugen ...chon erhielt im Jahre 1951 den Staatspreis ...Grades für „Krutnava" zuerkannt.

...Musik der Oper ist durchdrungen von den Melo...en und Rhythmen der slowakischen Volksmusik. ...epunkte des Werkes sind die tänzerisch be...ingte Bauernhochzeit des 3. Bildes (Foto oben) ... das letzte Finale der Oper, in dem das slowa...che Volk den Sieg der Wahrheit besingt. Der ...ative Gesangsstil herrscht, wie bei Leos Jana...vor, doch finden sich auch melodienreiche Solo...gsszenen und Ensembles. Durch eigenwillige ...monik und eine meisterhafte Instrumentierung ...ht es der Komponist, die jeweiligen Situatio... und die Personen eindrucksvoll zu charakteri.... Die Handlung spielt nach dem ersten Welt... in einem Gebirgsdorf der Slowakei.

doch den Ondrej Zimon heiraten. Der alte Stelina entschließt sich, den Mörder seines Sohnes allein zu suchen.

3. Bild. Einen Monat nach dem Mord heiratet Katrena Ondrej. Mitten in der Hochzeitszeremonie wirft der alte Stelina ihr vor, sie habe heute am Altar einen Meineid geschworen.

Der wütende Ondrej läßt sich wild zum Tanz aufspielen; er versichert seiner Frau seine Liebe.

4. Bild. Ein Jahr nach der Hochzeit. Katrena sitzt mit ihrem Kind allein zu Haus, während ihr Mann, wie so oft, im Wirtshaus ist. Katrenas Stiefmutter bemerkt, daß das Kind dem ähnlich sei, an den die Braut in der Hochzeitsnacht gedacht habe. Das hört der eintretende Ondrej. Aus einem Wortwechsel mit dem hinzukommenden Stelina entsteht eine Rauferei. Bild unten rechts: Katrena und Stelina.

Betrunken kehrt Ondrej in der Nacht aus der Schenke zurück. Er verirrt sich im Wald und gelangt auf die Stelle, wo er einst seinen Nebenbuhler getötet hat. Von Gewissensbissen gepeinigt, entschließt er sich, sich auf der Gendarmerie zu stellen.

5. Bild. Auf der Kirchweih bereden die Burschen

Streptomyzin

3.3.54

Zu unserer Sendung „Aus Natur und Technik"
Mittwoch, 16.50 Uhr, Berlin III

Noch vor 10 Jahren kannten die Ärzte gegen Tuberkulose keine andere Behandlungsweise als Ruhe, Diät und frische Luft. Die Chemotherapie, das heißt die chemische Beeinflussung von lebenden Krankheitserregern im Körper, hat uns durch die Entdeckung der sogenannten Antibiotika, zu denen das Streptomyzin gehört, ein wirksames Mittel mehr gegen diese gefährliche Krankheit in die Hand gegeben.
Klären wir zunächst die Frage: Was sind Antibiotika? Wir kennen heute etwa 50 verschiedene Arten von Spaltpilzen, die die Eigenschaft besitzen, bei ihrem Stoffwechsel bestimmte chemische Produkte auszuscheiden, die auf Bakterien eine wachstumhemmende oder -schädigende Wirkung ausüben. Sie sind also den Bakterien lebensfeindlich.
Die Geschichte der Antibiotika reicht bis ins vorige Jahrhundert zurück. Bereits im Jahre 1877 beobachteten Pasteur und Joubert, daß verschiedene Mikroorganismen auf ein- und demselben Nährmittelboden nicht gleichmäßig gut gedeihen. Aber erst im letzten Jahrzehnt wurde erstmalig ein Antibiotikum, das Penicillin, in größeren Mengen in der Medizin angewendet.

Prof. Dr. Knöll (rechts) im VEB Jenapharm

Aus dem Spaltpilz Streptomyces griseus wird Streptomyzin hergestellt. Es hat, wie wir bereits

Fig. 13: East-German Radio Journal "Unser Rundfunk", March 3, 1954

2. A glimpse on science in post World War II radio in two German states

Without really opening the complex and diverse history of radio and science communication in post-war Germany, I would like to point at one strand of constancy in the German case. In the West much of the Weimar model can be found. The *Gleichschaltung*, the totalitarian "integration" of all stations to a Reichsrundfunk, was redone. Science was still integral part of the general program of all federal stations, only it moved more and more from prime time to late night hours and mixed with philosophy and discussions of world view. The scientists on the air celebrated their universal knowledge – untainted by inferior politics. It would take roughly until 1960 that radio would turn to science as a process and the worker in the laboratory. Now again also with a critical approach.In the East, party politics took over the organization of radio eventually leading to a centralist structure and the party dependent "Society for the dissemination of scientific knowledge" (Gesellschaft zur Verbreitung wissenschaftlicher Kenntnisse) produced public science programs for the GDR radio. Here no philosopher-scientists but science workers took the scene, trying to paint a positive picture of the scientific potential of the socialist project. Only one invariant German feature seem to have survived which is exemplified in the fact that we again find Science and Opera side by side (Fig. 13). However, both the understanding of science and music has changed in the political light.[33]

33 Cf. 10 Jahre Gesellschaft zur Verbreitung wissenschaftlicher Kenntnisse, Erfurt 1964, and on radio in the GDR Dussel Rundfunkgeschichte (note 3), ch. 4.

Science in the French popular media in the 1930s and 40s: Radio, Songs and Cabaret

Daniel Raichvarg

Université de Bourgogne, Dijon

Impressions, Questions

In the 1930s and 40s the picture of French popular media looked roughly like this:

- odd jobs
- reviews or fashion magazines
- movies – documentaries or others
- radio programs, daily papers when news allows it - breaking news, front page columns… (a crime, a scientific event or others)
- theater plays, popular songs, cartoons, floor shows, were fostered by Science and Technology

Ready to vanish quickly as well as extremely diverse, these popular media forms – which were neither new nor old – drew a large audience, if not an almost infinite one. All these diverse manifestations within popular culture that also dealt with science and technology have hardly been scrutinized by scholarly investigation, which is, however, given the plethora of all these data not an easy task.

Among the questions that can be raised from these observations and which refer to various different – at times even conflicting – problems, are the following:

- What cultural pictures of science and technology did exist?
- How was the relationship between (public) knowledge and daily practices of science?
- How might an evaluation of forms and genres, especially taking into account cultural diversities and changes, look like?
- Can all this be described in terms of « l'espace public » or « citizenship » with regard to assessment, action, criticism etc.?

Till now, our failure to find an apposite solution to these dilemma – how difficult those impacts or effects are to measure(!) - might be taken as evidence of the disappearance of most of these popular forms from our modern consciousness, thoughts and fields of research. I'll discuss two examples of these forms – floor show and radio program – not really in order to give already definite answers, but more in order to exhibit some topics for discussion.

Starting rather from the end, I would like to discuss the idea that such concepts as "popular culture", "Doxa" and "laymen", "co-construction" and "legitimate science", though they are very interesting, do probably at the same time prevent us from appreciating their great value as a witness of a period in which a true popular scientific culture was starting to emerge.These concepts probably act as screen views ("conceptions écran") from understanding what *vulgarisation des sciences* really is.

The recent motto on the current situation of research on science popularization in the journal *Isis*, Arne Schirrmacher quoted for us in his introduction – "Too much science, too much English, too much 19th century" – also extends to the forms of presentations I am discussing here. These forms in particular cannot be considered from the single perspective of scientific knowledge. They do not belong to the 19th century which finally ended by the "bankruptcy" of science at least in France where a strong debate about bankruptcy of science took place beginnings in 1895. They rather belong to the 20th century some years after World War I, as exemplified by the Dada movement; and they were French. Let us start just here: French touch, French flair, French jokes, often hard to translate, a kind of "pat-a-cake" culture etc.

A floor show : Marie and Maurice

In October 1929, a monolog was delivered by an artist known as Dorgey at Pacra's Cabaret. This Cabaret was founded in the late 1880's, at that time it was named *Concert de l'Époque*, then *Concert Pacra* when Ernest Pacra, its founder, died in 1925. "Concert" or "Café concert" meant that one could have a drink and listen to music and a floor show artists, presenting mostly light songs and texts (Fig. 1).

The authors - Messieurs René-Paul and Georges Montax – decided to write the following epigraph for the published text of that monolog « Par le train qui emportait Maurice Chevalier partait également Madame Curie » (Les Journaux). ("Train which carried Maurice Chevalier away, carried too Mrs Curie away").

The story is about Maurice Chevalier, still a well-remembered French singer and actor, and Madame Curie, clearly an internationally recognized scientist. Marie Curie was leaving for the States to get some money for a few grams of Radium, while Maurice was leaving for the same destination for some extra Glory and probably much more dollars.

Par le train qui emportait Maurice Chevalier partait également Madame Curie

Il fait froid. Un ciel gris… Et Paris est en deuil.
Tout un peuple se sent frappé dans son orgueil.

La Gare Saint Lazare, en ce jour mémorable,
N'est qu'une procession de faces pitoyables,
De visages crispés. Sans cesse des métros,
Des tramways, autobus, jaillit le populo.

Les agents… doucement (!)… canalisent la foule.
Puis soudain c'est un cri qui jaillit et qui roule :
« Le voilà ! » On se presse, on entend des sanglots,
Bien vite dominés par le bruit des bravos.

Alors, c'est du délire, on se rue, on acclame
Le héros qui paraît. Sous ses pas bien des femmes
Effeuillent des bouquets. On le presse, on l'étreint,
Car dans quelques instants il doit prendre le train.

Mais au fait, quel est donc cet homme de génie ?
Le roi, probablement d'une nation amie,
Ou quelque aviateur vainqueur de l'Océan…
Ou bien encore un peintre, un glorieux savant ?

Non ! … Rien de tout cela… Ce héros que l'on fête,
C'est notre chevalier, notre Grande Vedette.
Maurice qui retourne au pays des Dollars,
Et tout Paris est là, saluant son départ.
On siffle « Valentine » et « Dites-moi, ma mère ! »
Un pâle imitateur tortille du postère,

Puis les cris : « Au revoir » se font touchants, émus.
Et le silence vient. Maurice a disparu.

Sur le quai du départ les employés s'affairent,
Un jazz fait retentir la nouveauté dernière
Du voyageur célèbre, et les opérateurs
Fixent pour les journaux son sourire vainqueur.

Soudain se faufilant parmi cette cohorte,
Une femme paraît, sans fleur et sans escorte.
Le seul « merci » pour elle est celui du porteur
Qui s'empresse déjà vers d'autres voyageurs.

Puis un coup de sifflet, le train part, accélère,
Emportant Chevalier que tout Paris vénère,
Et la femme au grand cœur que nul ne salua.
Pas le moindre officiel.

Un journal ce soir-là
Consacrait aux Echos quelques lignes polies
Annonçant le départ de Madame Curie.

Train which carried Maurice Chevalier away, carried too Mrs Curie away

It is cold. Sky is grey. And Paris is mourning.
A nation is struck in its pride

La Gare Saint Lazare in that memorable day
is but a procession of pathetic and tensed faces.
On and on, from tubes, trams, buses,
masses are spouting out.

Policemen – kindly – direct that crowd.
Then, all of a sudden, yells and screams
"Here he is". People are hurrying up. People are sobbing.
And people, very soon, say "Bravo".?

Then everybody's getting mad, rushing and cheering.
Hero's coming. Under his feet, women pluck petals.
He is squeezed, hugged because within a few
moments, he is going to catch the train.

But, actually, who is this man of genius ?
Maybe a King from one friendly country ?
Or an airman, conqueror of the oceans ?
Or else a paintor or a famous scientist ?

Nope… No one of that kind.. This hero to be celebrated ?
Our Chevalier, our great singing swinging star.
Maurice's getting back to Mr Dollar country.
The whole Paris is here to say him a warmful good bye.
One whistles "Valentine" and "Tell me, mother"
A poor mimic swings bottom and hips

Then cries become moving and nervous.
A stunning silence raises. Maurice vanishes.

On the departure platform, employees are fussing around.
A sound machine plays his last tune.
Cameramen get for their newspapers
his bright and conquering grin.

Suddenly, a woman is snaking in and out through this band
No escort, no flowers in her hand.
The only "thank you" for her is from the porter
Who is already hurrying towards another traveller.

A whistle. Train is leaving, speeding up,
Taking Chevalier away, that all Paris worship,
And that kindhearted woman that none greeted away.
No officials, no bureaucrates.

That evening, in its gossip column,
a newspaper spared a few polite lines
noting that she was on the go, Mrs Curie…

Fig. 1: Café Concert next to a Cinema in Paris. The "Concert Fauvette" (58, Avenue des Gobelins, 13th Arr.) was a second venue run by the Pacra family besides the "Concert Pacra" (10, Boulevard Beaumarchais, 11th Arr.) near the Bastille

For the purpose of this presentation I will rather not give a lot of information about these masterpieces, which would lead to many interesting details, but for a vivid approach to this popular media form, we should focus on the more general questions.

- Actually, I still do not know who the authors, Messieurs René-Paul and Georges Montax and the show man Dorgey were. However, according to some data I am aware of about song writers of the 19th century, like Léon Fourneau, alias Fornax (in Latin), alias Xanroff (in reverse letters, "à l'envers", "verlan") who wrote a lot of scientific songs for le Chat Noir or famous singer Yvette Guilbert in the late 19th century at the Moulin Rouge), this would provide enough work for a master degree or a Ph.D. dissertation. Why did these people decide to launch an attack against Maurice?
- To which extent is it possible to determine the effects of this kind of *vulgarisation scientifique*, or at least to describe how the audience reacted to this? Probably, extensive study of the daily papers might be a way.
- And still the main question has yet to be addressed: What exactly is the relationship between these forms of popular science and science proper? Do scientists reflect or even react on these public images of their activity?

Finally, if this example has an obvious lesson to teach us, it probably could be that the idiomatic and symbolic expression “public understanding of science” does not provide much insight in the more intricate relationship, I have just sketched.

Radio programs

What type of sources and data do we have in the case of radio programs that deal in one or other way with science? And what type of questions or thoughts could we draw from these information? Probably, one could start from the picture of two communities, a "radiophonic" and a "scientific", one that are living side by side or already intermingling with one another in order to promote if not a "community harmony" (some British cities have awards for people who help promote just this) but at least some new approaches. In times when a new media is introduced, the question of how this relationship develops seems to be most interesting.

Let us start by a quotation from the editorial of *L’Antenne, Journal français de vulgarisation de la TSF* (TSF means téléphonie sans fil, i. e. wireless telephony) of July 14, 1929:

> « As for wireless telephony, there is place for everyone : the amateur, the enthusiast would be as well the one who listens to Manon and Mr Colomb’s Scientific chatters through his radio set as well as the one who assembles or takes to pieces coils and capacitors or the one who tries to unravel the mystery of the propagation of waves. The former does appreciate first of all the artistic and educational side of this business while the latter admires the continuous progress of the technical world and the really astonishing results that are obtained by still more complicated lamps and submits facts to analysis and takes particular care to discover the causes of all the phenomena. »

This editorial, which is from the very same year when Dorgey performed his piece on Curie appeared in an issue of *L’Antenne* whose front page was dedicated to « new developments in electricity and radio » (Fig. 2). This gives us a precise idea of what the relationship of the « sans-filiste » with regard to science looked like and developed closely with the new media.

DIMANCHE 14 JUILLET 1929 — 24 PAGES : 1 FRANC — SEPTIEME ANNEE. — N° 329

L’Antenne

JOURNAL FRANÇAIS DE VULGARISATION TSF

Direction, Administration et Publicité : 53, Rue Réaumur, Paris (2e) Téléph. Louvre 03-7…

La plus forte vente nette des publications radiotechniques

Abonnements. — France : un an, 40 francs ; six mois, 22 francs. — Etranger : un an, 70 francs ; six mois, 38 francs. CHEQUES POSTAUX

Notre référendum

scientifique et intellectuelle, d’aborder les problèmes en face.

Certes, nous sommes encore loin de leur solution, mais il faut reconnaître que cette probité de l’esprit a été récompensée : la science

vides qui séparent ces particules et des espaces vides qui existent entre les éléments mêmes des particules.

Un exemple plus familier nous fera mieux comprendre. Nous con-

il écrit se tient supporté par cette table, parce que les molécules, les atomes, les électrons et protons qui la composent, en éternel mouvement, le bombardent du bas vers le haut sans arrêt.

Fig. 2: Title of L’Antenne. Journal française de la vulgarisation from 1929

Radio-T.S.F. et Radiovision

Conférenciers, Chroniqueurs & Comédiens

Blanche Vogt

Fig. 3: Summary of broadcasts from "speakers, reporters and entertainers" mentioning e. g. in the fourth column a program of M. George Colomb explaining "how the insight comes to the scientists" ("comment l'esprit vient aux savants)

The radio journals and often also the newspapers allow us to follow this movement of popularization day by day (and once again it is interesting to note that in *Isis Papers* Arne Schirrmacher considers that a very few newspapers are actually used as tools for our researches in such a way, as data allowing us to understand the cultural situation of popularization of sciences.

By means of the program listings of this *TSF* journals we can get an understanding what a grid of programs was available for a "sans filiste" audience that probably besides music and news wanted also to learn something about sciences.

For the year 1935, when there were three major radio stations of Tour Eiffel (E), Paris PTT (P) and Radio Paris (R), there was the following collection of programs just for one week:

Lundi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Lundi 17.30-18.00 (P)	une causerie scientifique par M. Vilmard
Lundi 18.30-18.45 (R)	un communiqué agricole
Lundi 19.45-19.53 (P)	un programme de vulgarisation technique (aéronautique, médical, bricolage, musées, horticulture)
Lundi 21.15-22.30 (R)	une chronique scientifique par Christophe.
Mardi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Mardi 14.00-14.10 (E)	une chronique scientifique donnée par l'Association Française pour l'Avancement des Sciences
Mardi 18.00-20.00 (P)	Voyages et Explorations
Mardi 18.30-18.45 (R)	un communiqué agricole
Mardi 19.20-19.30 (R)	Radio Dialogue agricole
Mardi 19.45-19.53 (P)	Causerie de vulgarisation scientifique par M. Augé
Mardi 19.53-20.00 (P)	Causerie sur la photo
Mercredi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Mercredi 17.05-17.30 (E)	une chronique scientifique donnée par l'Association Française pour l'Avancement des Sciences
Mercredi 18.00-18.10 (P)	un programme de vulgarisation technique (aéronautique, médical, bricolage, musées, horticulture)
Mercredi 18.30-18.45 (R)	un communiqué agricole
Mercredi 18.45-19.00 (R)	une causerie médicale
Jeudi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Jeudi 18.30-18.45 (R)	un communiqué agricole
Jeudi 19.45-19.53 (P)	un programme de vulgarisation technique (aéronautique, médical, bricolage, musées, horticulture)
Vendredi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Vendredi 14.00-14.10 (E)	une chronique scientifique donnée par l'Association Française pour l'Avancement des Sciences
Vendredi 18.30-18. 45 (R)	un communiqué agricole
Vendredi 21.15-22.30 (R)	Radio Cuisine, par Édouard de Pomiane
Samedi 13.30-13.40 (E)	une chronique agricole donnée par la Société des Agriculteurs Français
Samedi 18.00-18.30 (P),	Actualités scientifiques et littéraires
Samedi 18.30-18. 45 (R)	un communiqué agricole
Samedi 19.10-19.30 (R)	Conférence scientifique
Samedi 19.53-20.00 (P)	un programme de vulgarisation technique (aéronautique, médical, bricolage, musées, horticulture)
Dimanche 19.40-19.45 (P)	la chronique du vieux bricoleur

Fig. 4: Science programs of one week in 1935.

We can make the following observations:

- The range of programs was quite large, sciences, technology, agriculture, medicine was treated, in addition there were programs for the old-style do-it-yourselfer and already radio cooking.
- For this *Radio-Cuisine* the radio host was no other than the chief of the laboratory of physiology form Pasteur Institute, Édouard Pozerski, alias Édouard de Pomiane on the air. He used to punctuate his culinary advices by experiments of "gastrotechnie" and married "Cooking and Reasoning" (*Cuisine et Raisonnement* was also the title of the volume on his presentations that were published in 1934).
- The engineer Daniel Augé explained the principle of the new electrolytic valves coming from America. Do-it-yourself turned out to be a major opportunity to speak about science. Contrary to the position of the French Philosopher Georges Canguilhem, who wrote that "Sciences are more and more popularized through their effects, before being popularized through their causes and their principles", science on the radio was clearly offered to this audience of amateurs including talk on causes and principles[1]. In this way black-boxing of the content of science was not yet the problem.
- The programs of *Radio Agricole* were very diverse, ranging from school teaching, rates of the markets, technical advices, weather to advice on parasites or folklore. Moreover, different means of communication were used: talks, lectures, dialogs, interviews, short theater pieces, press reviews etc.
- The audience had even the opportunity to choose between science lectures of Georges Colomb on "let us see the boa eating" and of Jean Perrin on "the scientific genius and human evolution".

In most cases, however, journals and newspapers were very interested in the speakers. One section ("Lecturers, columnists and actors") discussed in particular the quality of the voice. In *Hebdo-T.S.F.* of May 5, 1929, one can read :

> « Recette : prenez une pleine poignée de bonne humeur, de simplicité, de rondeur, d'esprit, de gaie science, de douce philosophie et de persuasive bonté. Relevez le tout d'une pointe de malice où n'entre aucune amertume, et vous aurez un de ces mets savoureux, régal à la fois de l'oreille, de l'intelligence et du cœur qu'excelle à préparer, sous forme de causerie, M. George Colomb, humaniste, naturaliste, maître de conférences honoraire à la Sorbonne et jadis, sous le pseudonyme réjouissant de Christophe, auteur fameux de cette *Famille Fenouillard* qui fit la joie de nos jeunes années… M. G. Colomb est décidément le plus radiogénique de nos conférenciers et il devient une des attractions de Radio-Paris ».

In English:

> Recipe: take a handful of good humor, simplicity, roundness, wit, gay science, philosophy of gentle persuasion and kindness. Take everything with a hint of malice but without bitterness, and you have one of these tasty dishes that treat all ears, mind and heart that excels to prepare in the form of a *causerie*, George M. Colomb, humanist, naturalist, honorary lecturer at the Sorbonne and formerly

1 Georges Canguilhem, Nécessité de la Diffusion Scientifique, Revue de l'Enseignement supérieur, 1961.

> under the pseudonym of amusing Christopher, famous author of *Family Fenouillard* the delight of our younger years ... M. G. Colomb is definitely the most radiogenic of our speakers and he became one of the attractions of Radio Paris.

“Short stay guests” and “blind popularization” were the type of social relationship that science and radio were establishing. As Baudry de Saunier wrote as early as 1926 in *Initiation à la TSF* :

> “Radio can play an important part for popular education because the “Sans fil” is an elusive informant which can go as quickly in slams and in palaces”. This blind popularization is quite hard to understand for the speakers. If one could have a quite clear assessment of books selling, “everyday, a lot of lecturers speaking in the “auditoria” ask themselves if any audience is listening to what they are saying”.

George Truffaut, a gardening and flower shop owner and, at the same time, the host on gardening on Radio Paris, got the idea to launch a competition of the most beautiful rose. He was proud to receive 12.324 answers of listeners to his question; hence the audience of his program turned out to be surprisingly large. (A rose named “Madame Herriot” won, but this is a secondary result.)

Once again these elements show that the activities side by side of these two communities – the scientific and the so-called laymen or simply "the society" – interact in a rather complex manner:

- There is a kind of permanent mix between science and technology, knowledge and practice.
- There is a kind of permanent mix between daily life and daily forms (chatters like Century of Enlightenment)
- And as a new concept we find a “blind audience”, that is blind in probably more than one sense.

Other examples could be chosen, like numerous songs of science. They all could be considered as “popular media forms”. They all put forward a necessity: to think anew about our methods to investigate popularization of science. What we need is mostly a more cultural and communicational approach rather than an analytical centering on scientific content and norms. This might probably renew our conception of popularization and the place of these researches in the process of science and of history of science.

Appendix:

Towards New Perspectives in Popular Science Studies



Appendix

A) Ideas from the General Discussion

Schirrmacher
- We are currently in a stage where we collected the different approaches
- It seems necessary to me to widen the perspective and focus more on negotiation processes between science and public; there is also some input into sciences coming from this process
- Do we already know what comparative perspectives one should pursue?
- With regard to newspapers: The place in the paper, which is seldom mentioned, seems to play an important role.
- Are there common genres of writing, singing, ..., colored representations etc?
- How can we treat transnational influences? Were there networks of attention? Do we know who is looking on what developments? Relation to center-periphery discussion?
- Perspectives: Is ‘a’ European history possible at all?

Bowler
- It might be telling to compare what works in one country and does not catch on in others.
- We should distinguish between global and specific points.
- There are a number of different audiences, e.g. consider educationally interested vs. newspaper reader

Konovets
- The concept of mass communication might be helpful.

Hochadel
- My impression is that we are dealing with a bunch of pretty diverse papers. Hence it is not obvious how comparative perspectives could be selected.
- Ask STEP people for lessons:

Papanelopoulou
- Even for the cases of newspaper analysis the Greek and the Portuguese projects are not so similar as to be directly comparable, this also is true for the methodologies.

Simões
- The STEP group is still on a medium level concerning selection of topics of common interest, case studies etc.
- Side-by-side comparisons would be a possibility, probably in a joint paper.
- We should look how the STEP case studies may enable us to look now at the center in different ways.

Bergeron
- There is already much research we have to take into account. But do we only have to fill gaps?
- Different national contexts are very important. STEP may help.
- For comparison we need to identify a ‘central object’.

Zasztowt
- When we look after WW II, why should it not be possible to compare Poland and France? Both were centralized countries.
- 1968
- Do we find comparison besides better/worse situations?
- It seems worthwhile to analyze circles of intellectuals.
- Look also on book market, cf. PhD: number of translations from other nations: 1. German, 2. Britain, 3. France .. (>< Greece)

Hochadel
- It is rather straight-foreword to write comparisons if one keeps sticking to one topic.
- Supporting suggestion of Peter Bowler.
- Example: Einstein 1919.
- Look at history of professionalization of science communication in different countries (like Lightman, Daum etc. for 19th centruy): What was their background, training, ... do they see themselves as servants of science?
- How is popular science related to the frame of the nation? (pride, ... creation of...)
- How does it reflect broader changes in society (political, cultural...)?

Schirrmacher
- This, however, happened for big science nations already in 19th century!
- In 20th century things become more diverse: publics, formats, ...
- Hence, one might think that we don’t have national developments, rather transnational.

Bergeron
- Professionalization is a key perspective.

Zasztowt
- No, this is 19th century...

Bergeron
- What is true for writers, is half-true for journalists, but probably not true for people working in museums...
- The entrance is through professionalization, so it should be treated using existing studies from sociology etc. which have displayed interesting results.

Włodarczyk
- We should choose chanels: newpapers, radio ... and create databases. In principle they will answer any relevant question.

Zasztowt

- There were actually interesting examples, but how successful?

Schirrmacher

- We still need to tell each other what is known; this is probably to be done in other languages: Surveys of existing research.
- Planning was also a paradigm in Western countries. – Are we really this far apart?
- Oliver Hochadel's case shows that things are easier if one picks a special topic. So what about e.g. atomic physics <--> materialism in a wider context?
- Concerning popularization of science to different audiences that correspond to different levels of education, I think it is more interested in 'upper region' since here feedback phenomena into science occur.

Raichvarg

- Consider phases in which society is more or less distant form science, what about 1914, 1918?
- Central question should be how science is embedded in culture.

B) A preliminary landscape of 20th century science periodicals

Typically, the communication between science and public in a given time period with a certain political and societal stability becomes organized in a system of science communication. These different systems relating to different conditions are to to be identified. Informed by studies on system theory and knowledge (Luhmann 1990, Salvaggio/Barbesino 1996) the project mainly follows the two leads of Ludwik Fleck on the genesis and development of scientific findings and its various literary forms of communication, resp. (Fleck 1979). The first developed since the 1980s into a fruitful line of conceptional research (Golinski 1990, Harwood, 1993), while the second was only recently taken up, though there was of course independent analysis on the scientific publication systems (Meadows 1980, Holl 1996, Nikolow/ Schirrmacher 2007b). The focus of the approach, however, lies on a historical analysis of the modes of dissemination and at times the co-creation of knowledge by a bidirectional communication process between science and public (for detail see Schirrmacher 2008).

Such (historical) systems of science communication are characterized by

- a set of different media of science communication (e. g. journals, book series, newspaper sections or supplements, radio programs ...) addressing different core audiences in specific forms (genre, style, language, technicality, use of mathematics, graphs, images...),
- a differentiation of science communication with respect to the interest/involvement of the readers/consumers with science, i. e. scientists of other fields, educated classes, hobby researchers, interested groups, generally rather non-interested groups etc.,
- thus a differentiation into various markets segments, which is also mirrored by parameters like circulation, prizing, and the relation of subscription to street vending,
- life-cycles of organs of science communication, in particular for journals and newspaper sections that have been introduced at some time, probably underwent changes in title, quality, length and often terminated or were (at least formally) absorbed into competing publications.

In this way, for the example of journals, typically a leading journal for the community of all scientists (Nature, La Nature, Die Naturwissenschaften, ...) can be identified in most countries as well as a small number of prominent popular science journals and book series, which are often differentiated for an educated readership (Science Progress, Die Umschau, La revue scientifique, Ibérica, Wszechświat ...) and a readership more interested in illustrated and less technical presentation (Popular Science Magazine, Koralle, La science et la vie, El mundo científico, Tygodnik ilustrowany ...). See the following Table for a first overview of relevant sources.

Some Popular Science Journals and Book Series in 20th century Europe

	Britain (with US*)	France	Germany (GDR*)	Poland	Spain
Journals	*Scientific American, 1845- Nature, 1869- *Popular Science Monthly, 1872- Science Progress, 1894-1900, 1906-39, 1946- Knowledge, 1881-1917 Conquest. The Magazine of Popular Science, 1919-1926 Discovery. A Monthly Popular Journal of Knowledge, 1920-40, 1944-66 *Science News/Science Newsletter, 1922- Armchair Science, 1929-1940 New Scientist, 1956- *Discover, 1980- Focus/BBC Focus, 1992-	Cosmos, 1852-1914 La Nature, 1873-1961 La Revue Scientifique (Revue Rose), 1884-1959 Science & Vie 1913- La Science Moderne, 1924-1931 Ciel & espace, 1950 - Atomes,1946 -1970 Science & Avenir, 1947- Nucléus, 1960-1970 Science Progrès, 1963-1972 La Recherche, 1970 - Découverte, 1972 - Pour la Science [French Sci. American], 1977- Ça m'intéresse, 1981-	Naturwissenschaftliche Wochenschrift, 1887-1922 Prometheus, 1889-1921 Die Umschau, 1897-1986 Kosmos, 1904-1999 Natur, 1910-1927 Naturwissenschaften, 1913- Urania, 1924-1933 Die Koralle, 1925-1944 Wissen und Fortschritt, 1827-1943 Orion, 1946-1960 *Urania, 1947-1991 Naturwissenschaftliche Rundschau, 1948- *Wissenschaft und Fortschritt, 1951-1993 *Wissen und Leben, 1956-1962 Bild der Wissenschaft, 1964- Spektrum der Wissenschaft [German Sci. American], 1978- P. M., 1978-	Biblioteka Warszawska. Pismo poświęcone naukom, sztukom i przemysłowi, 1841-1914 Tygodnik Ilustrowany. Pismo obejmujące, ważniejsze wypadki współczesne, życiorysy znakomitych ludzi, 1859-1939 Wszechświat. Pismo przyrodnicze, 1882-1914, 1927- Kosmos. Czasopismo Polskiego Towarzystwa Przyrodnikow , 1876-1926 Przyroda i Technika. Miesięcznik poświęcony naukom przyrodniczym, rozwojowi przemysłu i rolnictwa , 1922-1939 Wiedza i Życie, 1926-1939, 1946-1962, 1963- Problemy. Miesięcznik poświęcony zagadnieniom wiedzy i życia, 1945- Świat Nauki [Polish Sci. American], 1991-	El mundo científico 1899-1912 La Ilustració Catalana, 1903-1917 Ciencia popular 1906-1907 Boletín de la Sociedad Astronómica de Barcelona (1910-1921) Ibérica. El progreso de las ciencias y sus aplicaciones, 1913-2004 Ciencia. Revista Catalana de Ciencia i Tecnología, 1926-1932, 1980-1991 Las Ciencias. La Asociación española para el progreso de la ciencias, 1975- Investigación y ciencia [Spanish Sci. American], 1977- Muy Interesante. La revista mensual para saber más de todo, 1981-
Book Series/ main Authors	Cambridge Manuals of Science and Literature XXth Century Science Series Home University Library Readable Books in Natural Knowledge Sixpenny Library	Bibliothèque de Merveilles (Hachette) Que sais-je?, 1941- Camille Flammarion (1842-1927) Marcel Boll (1886-1958) Henry de Gaffigny (1863-1934) Baudry de Saunier (1865-1938)	Sammlung Göschen Aus Natur und Geisteswelt (Teubner) Kosmos-Bändchen Wege zum Wissen (Ullstein) Verständliche Wissenschaft (Springer) Orion-Bücher Rowohlts deutsche Enzyklopädie, 1955-	Biblioteka Przemyslowa (Gebethner & Wolff), 1894-1947 Książki dla Wszystkich, 1901-13, 1918-47 Wiedza i Zycie (Books series) Biblioteka Popularnonaukowa	Biblioteca de Enseñanza Popular (1890-1910) Manuales Soler (1900-1950) Biblioteca de iniciación cultural (1920-1950) Josep Estalella (1879-1938) Joan Amades (1890-1959) Josep Comas Sola (1868-1937) Luis Miravitlles (1930-1995)

C) Notes on literature for some European regions*

Overview:

Research on "science popularization", "Wissenschaftspopularisierung", "vulgarisation scientifique", "divulgazione della scienza", "popularyzacja nauki" etc. have been carried out for various European countries for the 19th century or rather for the period covering the second half of the 19th century and up to World War I (Tuner 1980, Burnham 1987, Lightman 1997, Daum 1998, Béguet 1990, Bensaude-Vincent/Rasmussen 1997, Govoni 2002, Zasztowt 1988). Comparative perspectives are just currently pursued for the 19th century (cp. session 8A at 2008 joint meeting of HSS/BSHS/CSHS in Oxford) and mainly around 1900 for the European periphery (Papanelopoulou/Nieto-Galan/Perdriguero 2008).

As the "linear" or "diffusion" model of science popularization has been criticized repeatedly (Shinn/Whitley 1985, Hilgartner 1990) and rather close couplings between science, public, media and politics have been identified (Weingart 2001, 2005), alternative approaches that e. g. focus on an exchange relation of resources between science and public have been employed only recently in case studies from the 20th century (Nikolow/Schirrmacher 2007a). Further book-length studies on 20th century science communication were carried out for the US case (LaFollette 1989, 2008).

Great Britain (with US influences):

The discussion on chances and problems of popularization of knowledge and popular science is most extensive in the English language. The tradition can be traced back to the 17th century (Browne 1646) and classical texts of the early 19th century (Dick 1833). On the other side the first university textbook account on the topic has appeared recently (Broks 2006), that provides an almost up-to-date guide to the main literature. British and American developments, though different in some respect, cannot be separated, as books and journals as well as audiovisual media were distributed without restrictions. Also concerning the 20th century the state of research is advanced but, interestingly, much further for the US case (ch. 5 of Burnham 1987, LaFollette 1989, 2008) than for the British. Here a "misconception" or "myth" was spread, that "scientists deliberately turned their backs on non-specialist writing" and thus "abandoned the Victorian tradition of engagement with the public." (Bowler 2006, 160f.). Instead a great number of scientists, often on instigation of active publishers, produced a huge literature of popular accounts of their fields at least in the first half on the 20th century, which has scarcely been historically studied. When and to what extent science journalism changed the situation is currently discussed (Bowler 2006, Hughes 2007, Bauer/Gregory 2007); in addition the first comprehensive studies about science on radio and in documentary film and television have appeared recently (LaFollette 2008, Boon 2008).

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France

In France the interest in "vulgarisation scientifique" dates back to the 1960s, when already the necessity of science communication to the public was stressed and critical views on its relation to ideology were raised (Canguilhem 1961, Pradal 1968, Jurdant 1969) leading to the first book-length studies (Jurdant 1973). Since the 1980s an extensive literature on science popularization emerged with studies on specific journals (Denieuil 1982, Pestre 1988) or newspapers (Guéry 1985), on theoretical considerations (Hadj/Belisle 1985, Jacobi 1987, Schiele/Jacobi 1988, Fayard 1988) and on single popularizers (Bensaude-Vincent 1989, Fuentes/Cotardière 1994). A special bibliography on science popularization appeared in 1994 (Lamouroux 1994). In the French case studies on developments in the 20th century appeared early (Bensaude-Vincent/Blondel 1988, Pestre 1988, Bensaude-Vincent/Rasmussen 1997) and also general histories of science and public extended into the 20th century (Raichvarg/Jaques 1991, Raichvarg 2005). Nonetheless the view of a decline of science popularization around 1900 that ended a golden age became widespread (Béguet 1990, 1994, Laszlo 1993, Fox 2008). Recent interest focused on topics like the political impact of public images of science (Bensaude-Vincent 1999, 2003) and the role of television (Babou 2001, 2004).

Germany (and German speaking countries)

The interest in science popularization in Germany arose comparatively late. Though much work had been pursued on adult education in the 1970s and 1980s and some earlier discourse on the problem of "understandability" can be found (Glaser 1965, Gadamer 1978) as well as a discussion from the side of literary studies (Berentsen 1986) and on single popularizers (Szukaj 1996), a corresponding attempt to a historical analysis of popular science and science popularization, as it has been discussed in other counties, only came with the dissertation of Daum (Daum 1998), quickly followed by a comparative British-German study (Schwarz 1999), a study on Austria (Michler 1999) and a German-Austrian comparison (Felt 2000). A common trait of all these studies was to link the era of "Wissenschaftspopularisierung" with the political era before World War I, c. 1850-1914. The German research also focused much on humanities (Goschler 2000) and tried to apply this concept back up to early modern times and even antiquity (Kretschmann 2002). Systematic investigations into the history of science communication after World War I have started only in recent years (Ash/Stifter 2002, Nikolow/Schirrmacher 2007a, Daum 2008).

Poland

The popularisation of science as a research field became in Poland an important question after the Stalinist epoch (that was characterized by a rather close orientation and imitation of Soviet structures), i. e. beginning in the 1960s and 1970s. While communist rule broadly promoted the Marxist idea of a scientific consciousness and a kind of society of knowledge topics of general education remained at the center of concern (Miąso 1960, Reymont 1961, Kmiecik 1963, Moese 1963). It was, however, specific for Poland that besides topics like the education of workers (Krajewska 1979), also the role of the Catholic Church could be discussed (Poniatowski 1961). A first collective volume on theoretical questions of science communication appeared at the end of the 1970s (Wincenty 1979). In the difficult years of the 1980s that were determined both by the Solidarność movement and by martial law systematic and substantial historical studies on science popularization in the 18th and 19th century were begun and continued with the early years of the Third Republic. Here the historical scope also widened into the first half of the 20th century (Zasztowt 1983, 1987, 1988, 1992, Polish Academy of Sciences 1990, Potoczny 1998, Gorczyńska 1999). The current discourse is, however, mainly determined by the Polish efforts to establish or rather catch up with a modern knowledge society (Pawłowski 2004, Jabłoński 2006, Jaskowska 2006) and only few recent historical or theoretical studies can be identified (Connelly 2000, Płonka-Syroka 2005).

Spain

Research on science popularization (*divulgación*) started in Spain only in the post-Franco period when in the 1980s the new social and cultural history also considered science (Prats 1982, Ordoñez/Elena 1990). Since the 1990s a number of collective volumes appeared that contained predominantly 18th and 19th century case studies (Perdiguero 1992, Lafuente 1992, Arquiola/Martinez Perez 1995, Lafuente/Pimentel 2002). Roughly a the same time a debate on the question of the "image of science" in modern Spain arose (Lafuente/Elena 1996, Lafuente/Saraiva 1998, Nieto-Galan 1998) that brought the role of the public into the view of more and more authors. Thus since 2000 the discussion of science popularization became a rather important issue in general presentations of Spanish (and Catalan) history of Science (Nieto-Galan/Roca-Rosell 2000, Bertomeu-Sánchez/Garcia Belmar 2002, Martínez Vidal/Pardo Tomás 2004, Bertomeu-Sánchez/Nieto-Galan 2006) as well as in biographies (Roca-Rosell 2004) and genuine studies of Spanish history of science from the point of view of public presentation (Pohl 2007, González 2007).

Other regions

A book-length study is also available for Italy (Govoni 2002) as well as a study of science content in newspapers that includes a comparison of the situation in Italy, Britain and Bulgaria (Bucchi/Mazzolini 2007). Currently, the STEP initiative (Science and Technology in the Periphery) both pushed research on the history of science communication into the times of the 20th century and started to pursue a comparative approach of several southern, northern and eastern European countries like Portugal, Sweden, Hungary, Denmark and Italy (Nieto-Galan/Papanelopoulou 2006, Papanelopoulou/Nieto-Galan/Perdiguero 2008).

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