

INTRODUCTION TO THEMATIC SET OF PAPERS ON GEOLOGICAL SURVEYS

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Traditionally, the history of science has been by a large extent concerned with monitoring and investigating major advances in the mathematical and physical sciences, from the scientific revolution to today's achievements. Attention has also been devoted to a number of issues in the history of chemistry and of biology, though studies on the chemical revolution led by Lavoisier, or the Darwinian revolution, have usually prevailed. The history of earth sciences has been on the whole neglected, in spite of its intrinsic scientific interest, and crucial relevance to the history of modern and contemporary civilization, the modern State in particular.

Over the last two decades, much has changed in the history of science as a scholarly and institutional endeavour. A much wider problematic horizon has been taken into consideration, and growing attention is now paid to the social, political and institutional dimension of modern and contemporary science. New awareness and concern for the environment, biological diversity, or climatic change, has spurred research into a rich texture of issues, covering a time span ranging from the 18th century to today: naturalistic voyages and the birth of biogeography, the development of meteorological stations and modelling, the growth of collections and museums devoted to geology, palaeontology, and the history of our planet and of life in general.

The contributions to this issue of *Earth Sciences History* have been presented and discussed to an exploratory workshop made possible by the European Science Foundation and held in Paris in November 2005.¹ Surprising as it might appear, the institution, development, and – in some notable cases at least – fatal decline of Geological Surveys throughout Europe if not the whole planet is a domain of historical research still lacking systematic exploration and assessment, as pioneers in this field such as Clifford Nelson, David Oldroyd, Martin Rudwick or James Secord have pointed out. Moreover, as it will be stated below, the institutional problems now facing Geological Surveys in several countries is threatening the very existence of important archival material, indeed, of entire archives and museums. Far from being felt by historians alone, this concern is shared by field geologists, palaeontologists and cartographers, all well aware of the relevance and importance of records of careful fieldwork undertaken in the past for today's assessments of the physical structure – peculiarities and risks included – of given regions. Furthermore, the constitution and functioning of State agencies devoted to geological cartography in the early and mid decades of the Nineteenth Century represented one of the first examples

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of “big science” established in the western world, one that was exported to several colonial settings such as British India or Dutch Indonesia.

The surveying, drawing and publishing of a geological map covering the whole of a country required a sustained effort lasting for over fifty/sixty years on average; continuing Parliamentary and public opinion support proved vital when many of these ventures faced crucial crisis and damaging criticism (as it was the case in Italy during the 1880s and the 1920s, in France during the 1860s, or in Belgium during the 1870s), or when it was pointed out that none of the major economic returns emphatically promised by supporters of State geological maps had ever materialized. Geological maps involved the work of scores of geologists, collectors, draughtsmen, printers; the constitution of collections, schools and museums; the solution of litigations between state agencies and a variety of private and public institutions, concerning for instance the right to access private property or border regions under military administration.

The adoption of a comparative dimension is answering several needs. Firstly, the history of national Geological Surveys has so far been undertaken with unequal determination and success throughout Europe and the Western World. Whereas British, American, and Portuguese colleagues have done important groundwork and produced excellent studies, colleagues working in other countries readily acknowledge that their field of interest has not been so well served, or is undergoing right now a much delayed growth. Thus, the authors of the preliminary investigations on France, Italy, Belgium, Sweden, or Brazil here presented have greatly profited from comparing their research agendas with those developed by colleagues working on the United Kingdoms or Portugal and the United States.

Secondly, European Geological Surveys – just to restrict our comment to our Continent - constantly took inspiration the one from the other, on the positive as well as on the negative side. The British and French models (a centralized Agency, such as the British Geological Survey, or the French *Cartes Departamentales* project) were discussed as two possible ways to proceed, though after the mid of the nineteenth century it became increasingly clear that the choice of letting local governments directly take charge of geological surveys and cartography proved on the whole ineffectual. The Portuguese model of a “scientific” Geological Committee supervising fieldwork by mining engineers was also referred to when the Italian Geological Survey started in 1867 after a false start in 1862. In between, the efficient Austrian Geological Institute also attracted admiring comments, and countries entering the field adopted and adapted various combinations of the models already in existence.

Thirdly, national Geological Surveys relied on formal and informal networks of communication and exchange at Continental and Intercontinental level, the International Geological Congresses, started in Paris in 1878, being the major instance of attempts to coordinate nomenclatures, chromatic scales, and symbols to be used in the printed maps. Moreover, the Berlin-based project of a geological map of Europe also played a major and at times problematic role in the time-consuming negotiations between different and powerful national geological schools and cartographic traditions. Scientific personnel travelled frequently and extensively throughout the continent, giving a personal touch to a rich network of correspondences, exchange of maps and publications. Several State Geological Surveys relied on sister institutions for the training of their personnel. Thus, for instance, Italian mining engineers were trained at the *École de Mines* in Paris and Liège, and spent time in fieldwork at the UK Geological Survey.

The comparative assessment of the institutional chronology pertaining to individual

State Geological Surveys – the inevitable ups and down, the moments of crisis or the new lease of life that intervened here and there during the Nineteenth and the Twentieth Centuries – has indicated that a common thread did at times unite events occurring in Portugal and Italy, France, Belgium, and the United Kingdom. In other words, the crisis of the 1890s–1900s was common to several Geological Surveys, even though each contribution has stressed the seemingly exclusive local reasons for this. It is suggested that issues like the growth of the hygiene and sanitation movement, the question of water supplies and regulation, coupled with the growth of successful mining ventures in the United States or the colonies, put new pressure on the Geological Surveys across Europe. In other words, the changing perception of priorities to be taken into account in the relationship between national communities and their environment had an impact on the fate of Geological surveys and on the more or less successful adjustment of their research and public image agendas. Equally, the growth of earth sciences after World War II, the mounting institutional predominance of geophysics over field geology, affected several national Geological Surveys, to the point of bringing several to the brink of closure. With the downfall of classic geological surveying traditions, in countries like Italy, Portugal and France, the collection, library, and manuscript patrimony assembled over almost 150 years have been severely marginalized, threatened, and at times simply destroyed or dispersed. It is worth submitting to the attention of colleagues in the history of earth sciences the preliminary conclusions we reached in our discussions, and to provide a checklist of actions contributors to this issue of ESH felt should be undertaken in order to deepen our understanding of geological surveys, and to ensure the preservation of an important archival and data heritage.

Comparative chronologies

Almost all the papers referred in some detail to the ups and downs of the national geological survey they were dealing with (institutional uncertainties, disputes over field or cartographic work, dramatically fluctuating financing, repeated administrative or political threats to put an end to an endless undertaking, and so on). Are these vicissitudes only determined by local political and social factors, or do they reflect wider trends at European and world level? It seems clear, as pointed out above, that the relatively recent development of “Earth Sciences” has weakened already weak geological surveys in countries like France, Portugal or Italy, but not in Sweden, and in different ways in the UK. Towards the 1890s, scepticism was voiced concerning international geological gatherings, seen by the Italian administration, for instance, as producing little with a great expense. The need for new editions of already published geological maps Geological Survey staff argued for irritated politicians and administrators in several countries, weary of promises they felt unfulfilled: geologists were trying to eternalise their employment, it was suggested from Italy to the United States. Increased concentration on immediate, concrete problems such as water supplies to growing towns (the public hygiene and sanitary movement being a cause and a consequence at the same time) or to agriculture made geological surveys appear endless scientific undertakings one could perhaps dispense with. Trivial synoptic tables of major or minor events marking the life and dramas of single national surveys might perhaps help to catch a first glance at the problem.

How did they work?

Recruitment, training, personnel, career patterns, and salaries: these features of the internal working of geological surveys were not a mere function of financing. The large or small amounts of money allotted to surveys were partitioned in different ways, following more or less strong views of what geology and geological surveys ought to be. In Italy the little money there was, was very reluctantly allotted to finance precarious part-time jobs for a single palaeontologist, mining engineers and mineralogists being considered the chief protagonists of the surveying work. Thus the following question:

The politics of budgets

Who decided (Parliaments, Ministers, Directors General at the relevant ministries) the amount to be allocated to geological surveys, and who decided staffing and budget distribution within the Surveys? Were budgets negotiated year after year, or was there an overall estimation of the cost of producing a geological map over a given time period? Were there, once again, changes over the decades concerning the modalities (and quantities) of budget allocation at State level?

Legislation

Was there a legal status accorded to the geological surveys allowing (for instance) their personnel to enter properties or border regions under military administration? In France surveying personnel could benefit from the mining legislation declaring the richness of the underground open to State inspection and evaluation. Elsewhere (like in Italy or Brazil) this was not the case. With what consequences? Mineral ores discovered by surveying personnel in a given region belonged to whom? Was there any benefit or partial compensation accorded to surveying personnel? In other words, State legislation defining the field of competence of the administration with respect to private citizens and their property, or the organization of State intervention in the economy (motivated by crisis, or a state of war) constituted a framework for the action of Geological Surveys, and at times a limitation.

Theoretical allegiances

There has perhaps been an over-reaction against mere “theoretical”, “history of ideas like” histories of geology predominant up to the 1980s. We are finally getting a better grasp of geological practices in their complex social stratigraphy, as Simon Knell’s book has brilliantly shown, or of the role of non-verbal forms of communication Martin Rudwick has taught us to appreciate. Yet, different people clearly had views on what geology was, and how the earth surface had been shaped. Which body of knowledge, or disciplinary tradition, shaped and determined action? After all, theoretical views were often used to defend or to attack geological surveys: the long-standing competition between university geologists and surveying personnel found in many countries vociferous expression in debates calling in question the reliability of the theoretical framework adopted by the one or the other community. Were research traditions or new theoretical trends created by, or within GS? The training of personnel contemplated the use of manuals: if so, which ones? Were there regional theoretical allegiances? For instance, the

Franco-German uplifting proclivities: how far did they reach, and for how long? How did surveys react to new geological theories emerging at the end of the 19th century, and during the first 30 years of the 20th?

Relationship with rival scientific bodies, provincial or national

Which, if any, the relationship – personal and/or institutional – between geological surveys and other scientific bodies: Geological or Geographical Societies, Natural History Societies, Hydrological or Hydrographical departments within the State administration, and so on. More particularly, in several countries geological surveys were at time outflanked by local amateurs, provincial societies, or State departments producing maps directly or only tangentially geological (agricultural surveys and podological maps, geological maps produced in Italy by the Magistrato alle Acque (Water authority), geological maps proudly produced in France by local amateurs or learned societies, as Pierre Savaton has shown.

The technology and politics of printing a map

Several geological surveys had to face the serious problem of printing satisfactory maps: the presence or absence of local specialized printing facilities, the ways through which the State administration could deal with complex jobs like going through the printing of a sheet in several colours, the negotiations to find a printer outside national borders, thereby acknowledging a sort of national shortcoming. The crafts involved in preparing a map for printing: drawing has always accompanied research and printing in several branches of natural history. Yet, a geological map was always the result of teamwork and often of dissent among various factions within the survey or the geological community at large. Thus, drawing and printing had also a “political” dimension the technical articulation of the printing process had to take into account. Corrections proved expensive and difficult to justify to the Administration; new editions of geological maps were also at the centre of disputes, since the cost of undertaking a new print could be regarded as excessive by financial controllers or Parliament.

Interest groups and State interests

Agricultural societies or venture capital mining societies rarely shared the same kind of interest in geological surveys. Where they influential in bending priorities to their advantage, and, if so, for how long and how? Military geographical surveys were at times at the origin of, or preceded geological mapping ventures. At the national level, the balance of power within the various interests represented in the State administration probably conditioned the priorities of geological surveys, though in different ways in different countries. Were agricultural interests were predominant, they could impose an agenda to the survey, or in any case the survey leadership had to adopt a language and a rhetorical strategy likely to gain the favour of Parliament and the State bureaucracy. Colonial geological surveys should also claim a fair share of our attention, even though this field of historical research is less developed than research on national metropolitan surveys. Colleagues in other countries and disciplines (colonial science, for instance) could be solicited to provide guidance and information. The Imperial dimension of geological surveys was not limited to action within overseas colonies: the British,

Austrian or the Russia Empires had to deal with exploitation of potential resources within territories under their direct administration, or in any case enjoying the status of metropolitan provinces, not of colonies. Was there a difference between colonial and imperial surveys? How did countries that freed themselves from foreign administrations (the countries composing the Austrian empire, for instance) structure the goals of their surveys: a practical as well as symbolic recovery of the national soil through the survey, like in Poland, or with marked indifference to the problem, as it was the case with the Italian provinces formerly under Austria?

The international dimension

Throughout at least the first three quarters of the nineteenth century, the international dimension played a significant role in the structuring and financing of early geological surveys/offices/bureaux. The centuries-long competition between England and France, for instance, was certainly played upon by shrewd or just plainly convinced actors to argue the case of national honour being involved/compromised in staying behind. The British, the French and the Austrian models were much talked about as examples to be followed or to be avoided – this became particularly true of the French system unsuccessfully outsourcing regional mapping to local authorities. In general, the example of what was happening abroad in geological surveys was almost regularly called upon to exhort, convince, and spur local Governments to action. Up to the third quarter of the nineteenth century, the argument of geological surveys being the sign of the modernity of a State helped to get extra money to take part in international congresses, in funding the international congresses of geology in particular. The success of world exhibitions allowed interest groups (archaeologists, geographers, historians) to successfully propose similar worldwide disciplinary gatherings: geologists followed suit. The International geological congresses and the involvement of personnel from the national geological surveys in their organisation and politics should also be considered. For instance, during the first and second International geological congresses (Paris 1878, Bologna 1881) a complex political action was displayed by leading geologists to reward eminent colleagues with medals and honours, in order to enhance the public recognition of geology and geological surveys.

Networks

The issue of networks has loomed large in our discussion. Almost invariably, names came up, from Sweden to Portugal, from Italy to the British Isles that played a continental and at times intercontinental role within geological surveys worldwide: d’Omalius d’Halloy or Marcou, for instance, or Capellini and Torrel, Dewalque or Hauchecorne, Delgado, and many others. Several geological survey archives store rich treasures of correspondences, likely to be of use to historians of the geological survey a particular correspondent belonged to. Correspondences so far investigated reveal that chief protagonists of national geological surveys often relied on the help of colleagues abroad to exercise pressure, or to draw arguments in favour of their institutions. Specimens, maps, books and pamphlets, journals and minerals travelled in earnest throughout Europe and the world. Often, as it was the case with the Italian *Ufficio Geologico*, a scientific periodical was set up with the expressed intent to make one’s work known, but more importantly to get expensive journals and books from abroad through a policy of

exchange. The cost of printing a journal turned out to be a relatively small investment if compared to the economic return represented by the literally hundred publications coming in for free thanks to institutional and personal networking.

The truly European, if not worldwide dimension of geological surveys needs all the attention we can provide. Networks of correspondence and exchange were essential to the pursuit of surveying work, to the updating of information (scientific and cartographic), to the political strategies deployed by survey personnel in time of crisis. Thus, for instance, Felice Giordano, the energetic and pugnacious head of the Italian geological survey from 1878 through 1892, kept abreast of what was going on in geological surveys worldwide, solicited letters and memoranda from colleagues illustrating the advantages or shortcomings of organisational models implemented here and there, to be used to brief Chief Whips in the House, or MPs he could mobilize against MPs speaking on behalf of critics of the Italian Survey. A good international network proved at times a good insurance against political hazards.

Suggestions for action

Archives and Collections.

Over and over, our discussions turned to consider the state of archives, museums, collections relating to national geological surveys. In many countries, this is a heritage in serious danger. Not that everything could and should be preserved, but choices will have to be made, information preserved, archives evaluated in order to avoid indiscriminate destruction. It has often been pointed out that much of the survey field notes, specimens or manuscript maps are still of value today. They should therefore be preserved and studied.

An electronic calendar of correspondences

This could be easily set on foot, coupled with a prosopographic database. This could be done at two levels. Firstly, following the example of the British Public Record Office project dealing with “British Scientists, 1600-2000”, a simple calendar of correspondences/ correspondents present in a given collection could be established. The list could be regularly updated, and would constitute an invaluable store of information. At a more sophisticated level, scannerised letters might be put on line, because of their crucial importance, because of their rarity, because of the danger of destruction threatening them. A summary in English could be provided for each or part of the letters thus made available, with, when possible, the translation in English of significant passages available in the original language. We could, in other words, bring networks back to life, thus providing each of us with research material we would have to travel months if not years to gather, and creating at the same time a model for research cooperation at continental as well as intercontinental level.

Maps on line

Following the example of what is currently being achieved, for instance, by the E-Geo project at the University of Siena, led by Professor Carmignani (almost all historical and contemporary geological maps of Italy are available on line at the address <http://>

www.egeo.unisi.it/), systematic investigation of the cartographic heritage produced in different countries, by Geological Surveys, other Agencies or individuals, could lead to the creation of a database monitoring the different stages through which our understanding of the territory of Europe has been developed.

Histmap: the creation of a disciplinary space on the Internet

Internet technologies make it possible to envisage the creation of an open disciplinary space devoted to the history and present state of geological cartography in Europe (though the ambition might be potentially planetary). Historians and geologists, archivists and librarians, could exchange information and research results, evaluate collections items or the dating of individual maps (not a simple problem, due to the huge time-gap intervening at times between the field work, the drawing of a map, and its final printing). More importantly, together with the publication of collective or individual essays in print, the disciplinary space could offer a quick access to the state of the historiography concerning the geological cartography of a given country, region or Continent. In other words, attention should be paid to the drafting of texts to the benefit of the general public, today very attentive to the issue of risk, and the protection and preservation of the environment. The study of earthquakes and volcanic phenomena, of landslides and marine erosion loomed large in the work of several Geological Surveys: to document the development of our understanding of the territory where we live can be of use in the classroom and of interest to the educated public. The flexibility of the electronic medium will thus allow the pursuit of a multi-level strategy, ranging from the preservation and enhancement of a scientific heritage, the publications of texts, maps and studies, and the realisation of pedagogical pathways capable of answering a variety of questions relating to a given country, region, geographic area.

The website (www.hstl.crhst.cnrs.fr/i-corpus/histmap) represents a preliminary model of the kind of action we would like to undertake, calling upon colleagues of all European countries and beyond. So far, thanks to the exploratory workshop, colleagues from Canada, Mexico and Brazil have sent their work on the Geological Surveys of their countries. Colleagues from Norway, India, Greece and Holland have expressed their willingness to take part in this collective work.